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Open Science

Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

Open Science Index

The Open Science Index (OSI) currently provides access to over thirty thousand full-text journal articles and is working with member and non-member organizations to review policies to promote and assess open science. As part of the open science philosophy, and by making open science a reality; OSI is conducting an assessment of the impact of open science principles and restructuring the guidelines for access to scientific research. As digitalization continues to accelerate science, Open science and big data hold enormous promise and present new challenges for policymakers, scientific institutions, and individual researchers.

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Open Science

Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

Open Science

Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

Open Science

or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. These changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

Open Science

engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

Open Science

towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed' sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

Open Science

Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

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TABLE OF CONTENTS

1	FEM Method and the Rayleigh Quotient for Structural Element Vibration Analysis <i>Falek Kamel</i>	1
2	Stereoselective Glycosylation and Functionalization of Unbiased Site of Sweet System via Dual-Catalytic Transition Metal Systems/Wittig Reaction <i>Mukul R. Gupta, Rajkumar Gandhi, Rajitha Sachan, Naveen K. Khare</i>	2
3	Catalyst Assisted Microwave Plasma for NO _x Formation <i>Babak Sadeghi, Rony Snyders, Marie-Paule.Delplancke-Ogletree</i>	4
4	Functionalizing Gold Nanostars with Ninhydrin as Vehicle Molecule for Biomedical Applications <i>Swati Mishra</i>	5
5	Current Design Approach for Seismic Resistant Automated Rack Supported Warehouses: Strong Points and Critical Aspects <i>Agnese Natali, Francesco Morelli, Walter Salvatore</i>	7
6	High Strength Steel Thin-Walled Cold-Formed Profiles Manufactured for Automated Rack Supported Warehouses <i>A. Natali, F. V. Lippi, F. Morelli, W. Salvatore, J. H. M. De Paula Filho, P. Pol</i>	8
7	Acoustic Characterization of labiovellarized Berber Consonants <i>Falek Leila</i>	9
8	Twice-Over Object Detection Methodology: Forced Humanization for Explainability of Artificial Intelligence <i>Sarah Reynolds, Brian Butka</i>	10
9	Memory Forensics Tools Quantification and Ranking <i>Olaide Afolabi, Faith Adegbienro, Prudence Philips, Grace Owolabi, Hassan Salmani, Stanley L. Harris Jr., Bevan Ngo, George A. Jarvis</i>	11
10	A Quinary Coding and Matrix Structure Based Channel Hopping Algorithm for Blind Rendezvous in Cognitive Radio Networks <i>Qinglin Liu, Zhiyong Lin, Zongheng Wei, Jianfeng Wen, Congming Yi, Hai Liu</i>	17
11	Compact Microstrip Ultra-Wideband Bandstop Filter With Quasi-Elliptic Function Response <i>Hussein Shams, Faris Almansour</i>	27
12	Investigation of Gravity Anchor Under Scour, and Anchor Transportation and Installation (T&I) <i>Vinay Kumar Vanjakula, Frank Adam</i>	31
13	3-Dimensional Contamination Conceptual Site Model: A Case Study Illustrating the Multiple Applications of Developing and Maintaining a 3D Contamination Model during an Active Remediation Project on a Former Urban Gasworks Site <i>Duncan Fraser</i>	32
14	Human Wildlife Conflict Outside Protected Areas of Nepal: Causes, Consequences and Mitigation Strategies <i>Kedar Baral</i>	33
15	Parasitic Infection among Farmers Dealing with Treated Wastewater in Al-Zaitoun Area, Gaza City <i>Haneen Nabil Al-Sbaihi, Adnan Al-Hindi, Khalid Qahman</i>	34
16	Modified Otsuka Method for Local TEC Mapping <i>F. I. Constantin, E. M. Popescu, G. Chiritoi, E. I. Năstase, A. Muntean</i>	38
17	The Nature of Mineralizing Fluids in the Hammam Zriba Deposit (F-Ba-Sr-Pb-Zn) in North-eastern Tunisia <i>Miladi Yasmine, Bouhlel Salah, David Banks</i>	39

	Identification of the Usage of Some Special Places in the Prehistoric Site of Tapeh Zagheh through Multi-	
18	Elemental Chemical Analysis of the Soil Samples <i>Iraj Rezaei, Kamal Al Din Niknami</i>	40
19	Relationship between Micro-Level Entrepreneurial Resilience with Job Satisfaction and Family Social Support <i>Kristiana Haryanti, Theresia Dwi Hastuti, Agustine Eva Maria Soekesi</i>	41
20	Effect of Company Value, Leadership, and Ownership Succession on Financial Performance of Family Business <i>Theresia Dwi Hastuti, Kristiana Haryanti, Agustine Eva Maria Soekesi</i>	42
21	Online Interior Design Management System <i>Aamir Abdirahman Hussein, Osman Asia Mohamed, Collins Odour</i>	43
22	Evaluation of Free Technologies as Tools for Business Process Management <i>Julio Sotomayor, Daniel Yucra, Jorge Mayhuasca</i>	57
23	An Elaboration Likelihood Model to Evaluate Consumer Behavior on Facebook Marketplace: Trust on Seller as a Moderator <i>Sharmistha Chowdhury, Shuva Chowdhury</i>	65
24	Effect of Fiscal Policy on Growth in India <i>Parma Chakravarti</i>	66
25	Determinants of Financial Performance of South African Businesses in Africa: Evidence from JSE Listed Telecommunications Companies <i>Nomakhosi Tshuma, Carley Chetty</i>	67
26	Semigroup Lattices of Completely 0-Simple Semigroups <i>P. G. Romeo, Alanka Thomas</i>	68
27	The Impact of COVID-19 on Portfolio Allocation <i>Yulin (Rain) Zhai</i>	77
28	Integral Domains and Alexandroff Topology <i>Shai Sarussi</i>	94
29	Artificial Intelligence Technologies Used in Healthcare: Its Implication on the Healthcare Workforce and Applications in the Diagnosis of Diseases <i>Rowanda Daoud Ahmed, Mansoor Abdulhak, Muhammad Azeem Afzal, Sezer Filiz, Usama Ahmad Mughal</i>	95
30	Latest Results from the CUORE Experiment <i>CUORE Coll.</i>	101
31	Challenges in the Assessment of the Relationships Between Urban Green Landscape Aesthetics and Biodiversity <i>Kseniia Zakharova</i>	102
32	Changes in Pain Intensity of Musculoskeletal Disorders in Flight Attendants after Stretching Exercise Program <i>Maria Melania Muda, Retro Wibawanti, Retno Asti Werdhani</i>	103
33	Simulations to Predict Solar Energy Potential by ERA5 Application at North Africa <i>U. Ali Rahoma, Nabil Esawy, Fawzia Ibrahim Moursy, A. H. Hassan, Samy A. Khalil, Ashraf S. Khamees</i>	110
34	Impact of a Solar System Designed to Improve the Microclimate of an Agricultural Greenhouse <i>Nora Arbaoui, Rachid Tadili</i>	136
35	Verification of Satellite and Observation Measurements to Build Solar Energy Projects in North Africa <i>Samy A. Khalil, U. Ali Rahoma</i>	137
36	Software-Defined Networks in Utility Power Networks <i>Ava Salmanpour, Hanieh Saeedi, Payam Rouhi, Elahe Hamzei, Shima Alimohammadi, Siamak Hossein Khalaj, Mohammad Asadian</i>	155
37	Experimental Study of Hydrothermal Properties of Cool Pavements to Mitigate Urban Heat Islands <i>Youssef Wardeh, Elias Kinab, Pierre Rahme, Gilles Escadeillas, Stephane Ginestet</i>	162

	Synthesis and Characterization of Crosslinked Macroporous Silanized Magnetic Polymer Nanocomposites	
38	Based on Glycidyl Methacrylate <i>Ljiljana Suručić, Aleksandra Nastasović, Bojana Marković, Tamara Tadić, Antonije Onja</i>	163
39	Leuco Dye-Based Thermochromic Systems for Application in Temperature Sensing <i>Magdalena Wilk-Kozubek, Magdalena Rowińska, Krzysztof Rola, Joanna Cybińska</i>	164
40	Sonication as a Versatile Tool for Photocatalysts' Synthesis and Intensification of Flow Photocatalytic Processes Within the Lignocellulose Valorization Concept <i>J. C. Colmenares, M. Paszkiewicz-Gawron, D. Lomot, S. R. Pradhan, A. Qayyum</i>	165
41	Kinetic Resolution of Racemic Mixtures via Enantioselective Photocatalysis <i>Nitai Arbell, Kesem Bauer, Yaron Paz</i>	166
42	Green Amphiphilic Nanostructures from CNSL <i>Ermelinda Bloise, Giuseppe Mele</i>	190
43	Fluorescent Terbium-organic framework-doped Polyethylene Composites for FDM 3D Printing in Packaging Security Features <i>Youssef R. Hassan, Mohamed S. Hasanin, Reda M. Abdelhameed</i>	191
44	Water Balance Components under Climate Change in Croatia <i>Jelena Bašić, Višnica Vučetić, Mislav Anić, Tomislav Bašić</i>	192
45	The Agroclimatic Atlas of Croatia for the Periods 1981–2010 and 1991–2020 <i>Višnica Vučetić, Mislav Anić, Jelena Bašić, Petra Sviličić, Ivana Tomašević</i>	193
46	Artificial Seed Production in Stipagrostis pennata <i>Masoumeh Asadi Aghbolaghi, Beata Dedicova, Farzad Sharifzadeh, Mansoor Omidi, Ulrika Egertsdotter</i>	194
47	Agriculture and Climate Change in the Middle East and North Africa Region <i>Assaad Ghazouani</i>	202
48	Steroid Nuclear Receptor Coactivator 2 Controls Immune Tolerance by Promoting Induced Treg Differentiation via Upregulating Nr4a2 <i>Wencan Zhang, Xu Cao, Xiancai Zhong, Hongmin Wu, Mingye Feng, Yousang Gwack, Isakov Noah, Zuoming Sun</i>	212
49	Beneficiation of Pulp and Paper Mill Sludge for the Generation of Single Cell Protein for Fish Farming <i>Lucretia Ramnath</i>	213
50	Machine Learning as an Efficient Tool to Define Microstructure of Fibrillar Biomolecules by Means of Dynamic Rheometry <i>Karina Núñez, Cristian Velasco, Julia Guerrero, María Asensio, Juan Carlos Merino</i>	214
51	Indigenous Engagement: Towards a Culturally Sensitive Approach for Inclusive Economic Development <i>Karla N. Penna, Eloise J. Hoffman, Tonya R. Carter</i>	216
52	Flood Hazard and Risk Mapping to Assess Ice-Jam Flood Mitigation Measures <i>Karl-Erich Lindenschmidt, Apurba Das, Joel Trudell, Keanne Russell</i>	223
53	Happiness and Peace in Daily Mindfulness <i>Ven. Dharma Sen</i>	224
54	Uncertainties and Resilience: A Study of Pandemic Impact on the Pastoral-Nomadic Communities in India <i>Arati S. Kade, Iftikhar Hussain, Somnath Dadas</i>	227
55	Cognitive and Functional Analysis of Experiencer Subject and Experiencer Object Psychological Predicate Constructions in French <i>Carine Kawakami</i>	236
56	Compliance and Assessment Process of Information Technology in Accounting, in Turkey <i>Kocakaya Eda, Argun Doğan</i>	237
57	Advertising Incentives of National Brands against Private Labels <i>Lu Liao</i>	238

58	Chatbots in Education: Case of Development Using a Chatbot Development Platform <i>Dulani Jayasuriya</i>	239
59	Bellum Letale: Evidence from Nagorno-Karabakh War <i>Arevik Sargsyan</i>	240
60	THE CARBON TAX AND THE EMISSIONS TRADING SYSTEM AN ANALYSIS OF THE PERFORMANCE OF THE TWO MECHANISMS <i>Assaad Ghazouani</i>	241
61	Information Technology Governance Implementation and Its Determinants in the Egyptian Market <i>Nariman O. Kandil, Ehab K. Abou-Elkheir, Amr M. Kotb</i>	252
62	Adaption to Climate Change as a Challenge for the Manufacturing Industry: Finding Business Strategies by Game-Based Learning <i>Jan Schmitt, Sophie Fischer</i>	261
63	Hybrid Image of Multiple Fantastical Characters <i>Juhapekka Ollikainen</i>	262
64	An Analysis of How Students Perceive Their Self-Efficacy in Online Speaking Classes <i>Heny Hartono, Cecilia Titiek Murniati</i>	264
65	Play-Based Learning Is Beneficial for the Learning and Development of Young Children in an Early Years Education Context from Perspectives of Mathematics Learning Attainment, Linguistic Capabilities and Social Skills <i>Shuting Deng</i>	265
66	Benefits of Gamification in Agile Software Project Courses <i>Nina Dzamashvili Fogelström</i>	273
67	The Decision-Making Process of the Central Banks of Brazil and India in Regional Integration: A Comparative Analysis of MERCOSUR and SAARC (2003-2014) <i>Andre Sanches Siqueira Campos</i>	279
68	Assessing the Effectiveness of a Field Project Program Course <i>Shubhra P. Gaur, Perpetua Fernandes</i>	280
69	Impact of Job Crafting on Work Engagement and Well-Being among Indian Working Professionals <i>Arjita Jhingran</i>	281
70	The Negative Impact of the SARS-CoV-2 Pandemic on Maternal and Child Health, Considering Maternal Experiences of Abuse and Neglect in Childhood <i>Franziska Köhler-Dauner, Inka Mayer, Lara Hart, Ute Ziegenhain, Jörg M. Fegert</i>	282
71	Destination Management Organization in the Digital Era: A Data Framework to Leverage Collective Intelligence <i>Alfredo Fortunato, Carmelo Francesco Origlia, Sara Laurita, Rossella Nicoletti</i>	283
72	Detecting Memory-Related Gene Modules in sc/snRNA-seq Data by Deep-Learning <i>Yong Chen</i>	284
73	The Art of Being Healthy to Help Others to Stay Healthy <i>Claude Kamga Defo, Chantal Legault, Yasaman Hadian</i>	285
74	Experiences of 529 Donor-Conceived Adults: Disclosure, Using a Donor, Donating <i>Wendy Kramer</i>	286
75	Children Asthma; The Role of Molecular Pathways and Novel Saliva Biomarkers Assay <i>Seyedahmad Hosseini, Mohammadjavad Sotoudeheian</i>	287
76	Counseling all Donor Family Members: A Guide for Mental Health Professionals <i>Wendy Kramer</i>	288
77	Epicardial Fat Necrosis in a Young Female: A Case Report <i>Tayyibah Shah Alam, Joe Thomas, Nayantara Shenoy</i>	289

	The Role of Txnrd2 Deficiency in Epithelial-to-Mesenchymal-Transition (EMT) and Tumor Formation in	
78	Pancreatic Cancer	290
	<i>Chao Wu</i>	
79	Factors Influencing Implementation of Simulation in Nursing and Midwifery Education in Malawi	291
	<i>Gertrude Mwalabu, Masauko Msiska, Ingrid Tjoflåt, Patrick Mapulanga, Annie Msosa</i>	

FEM Method and the Rayleigh Quotient for Structural Element Vibration Analysis

Falek Kamel

Corresponding author's address: Structures and materials, USTHB, USTHB, Faculty of Civil Engineering, Algiers, 16111, Bab Ezzouar, Algeria,

Email : kfalekgc@yahoo.fr ; falek.kamel@gmail.com

Abstract

Various approaches are usually used in the dynamic analysis of beams vibrating transversally. For this, numerical methods allowing the solving of the general eigenvalue problem are utilized. The equilibrium equations, describing the movement, result from the solution of a fourth order differential equation. Our investigation is based on the finite element method. The findings of these investigations are the vibration frequencies, obtained by the Jacobi method. Two types of elementary mass matrix are considered, representing a uniform distribution of the mass along the element and concentrated ones located at fixed points whose number is increased progressively separated by equal distances at each evaluation stage. The studied beams have different boundary constraints representing several classical situations. Comparisons are made for beams where the distributed mass is replaced by n concentrated masses. As expected, the first calculus stage is to obtain the lowest number of the beam parts that gives a frequency comparable to that issued from the Rayleigh formula. The obtained values are then compared to theoretical results based on the assumptions of the Bernoulli-Euler theory. These steps are used after for the second type mass representation in the same manner.

Keywords : Structural elements, beams vibrating , dynamic analysis ; finite element method ; Jacobi method.

Stereoselective Glycosylation and Functionalization of Unbiased Site of Sweet System *via* Dual-Catalytic Transition Metal Systems/Wittig reaction

Mukul R. Gupta^{†, §, ‡}, Rajkumar Gandhi[§], Rajitha Sachan[§] and Naveen K. Khare^{*, ‡}

[†] Drug Discovery Division, Piramal Pharma Limited, Plot # 18 Pharmaceutical Special Economic Zone, Ahmedabad, Gujarat 382213

[§] R & D and Synthesis Department, Sigma Aldrich-Merck Pvt. Ltd. Bengaluru 560099, India

[‡] Department of Chemistry, University of Lucknow, Lucknow 226007, India

Abstract— The field of glycoscience has burgeoned in the last several decades, leading to the identification of many glycosides which could serve critical roles in a wide range of biological processes. This has prompted resurgence in synthetic interest, with a particular focus on new approaches to construct the selective glycosidic bond. Despite the numerous elegant strategies and methods developed for the formation of glycosidic bonds, stereoselective construction of glycosides remains challenging. Here, we have recently developed the novel Hexafluoroisopropanol (HFIP) catalyzed stereoselective glycosylation methods by using KDN imidate glycosyl donor and variety of alcohols in excellent yield. This method is broadly applicable to a wide range of substrates and with excellent selectivity of the glycoside.

Also, herein we are reporting the functionalization of unbiased side of newly formed glycosides by dual-catalytic transition metal systems (Ru- or Fe-). We are using the innovative Reverse & Catalyst strategy, i.e. a reversible activation reaction by one catalyst with a functionalization reaction by another catalyst, together enabling functionalization of substrates at their inherently unreactive sites. As well we are targeting the diSia derivative synthesis by wittig reaction. This synthetic method is applicable in mild conditions, functional group tolerance of the dual-catalytic systems and also highlights the potential of the multicatalytic approach to address challenging transformations to avoid multistep procedures in carbohydrate synthesis.

Keywords- KDN, stereoselective glycosylation, dual-catalytic functionalization, Wittig reaction

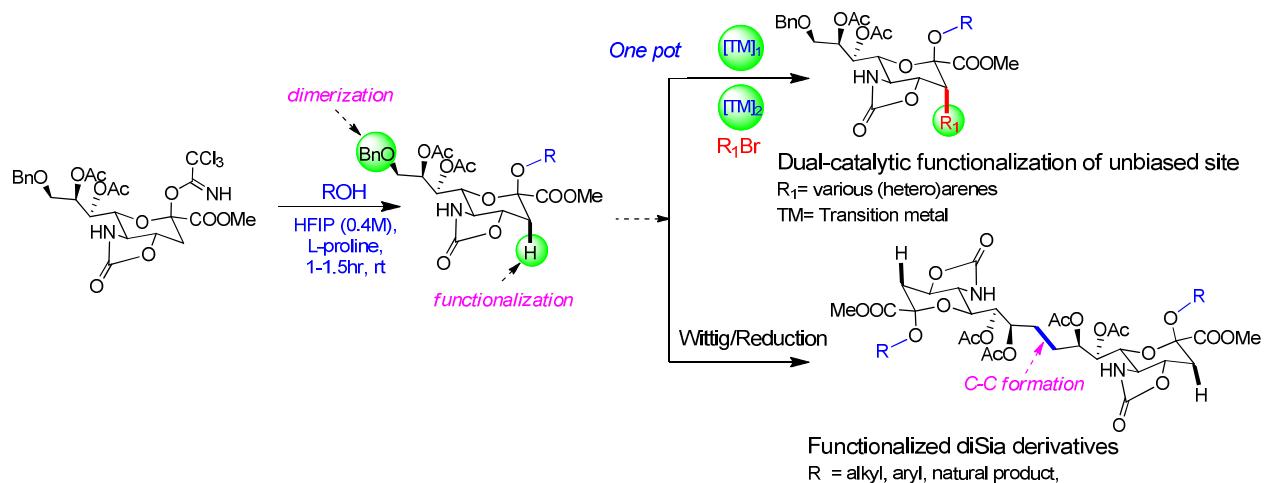


Figure 1. Stereoselective Glycosylation and Functionalization of Unbiased Site of Sweet System

Catalyst Assisted Microwave Plasma for NO_x Formation

B. Sadeghi, R. Snyders, M. P. Delplancke

Abstract—Nitrogen fixation (NF) is one of the crucial industrial processes. Many attempts have been made in order to artificially fix nitrogen and among them the Haber-Bosch's (H-B) process is widely used. However, it presents two major drawbacks: a huge fossil feedstock consumption and noticeable greenhouse gases emission. It is therefore necessary to develop alternatives. Plasma technology, as an inherent “green” technology, is considered to have a great potential for reducing the environmental impacts and improving the energy efficiency of the NF process.

In this work, we have studied the catalyst assisted microwave plasma for NF application. Heterogeneous catalysts of MoO₃, with various loads 0, 5, 10, 20, and 30 wt%, supported on γ -alumina were prepared by conventional wet impregnation. Crystallinity, surface area, pore size and microstructure were obtained by X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) adsorption isotherm, Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). The XRD patterns of calcined alumina confirm the γ - phase. Characteristic picks of MoO₃ could not be observed for low loads (< 20 wt%) likely indicating a high dispersion of metal oxide over the support. The specific surface area along with pores size are decreasing with increasing calcination temperature and MoO₃ loading. The MoO₃ loading does not modify the microstructure. TEM and SEM results for loading inferior to 20 wt% are coherent with a monolayer of MoO₃ on the support as proposed elsewhere. For loading of 20 wt% and more, TEM and Electron diffraction (ED) show nanocrystalline 3-D MoO₃ particles.

The catalytic performances of these catalysts were investigated in the post-discharge of a microwave plasma for NO_x formation from N₂/O₂ mixtures. The plasma is sustained by a surface wave launched in a quartz tube via a surfaguide supplied by a 2.45 GHz microwave generator in pulse mode. In-situ identification and quantification of the products were carried out by Fourier-transform infrared spectroscopy (FTIR) in the post-discharge region. FTIR analysis of the exhausted gas reveal NO and NO₂ bands in presence of catalyst while only NO band were assigned without catalyst. On the other hand, in presence of catalyst, a 10% increase of NO_x formation and of 20% increase in energy efficiency are observed.

Keywords— γ -Al₂O₃-MoO₃, μ -wave plasma, N₂ fixation, Plasma-catalysis, Plasma diagnostic.

B. Sadeghi is with the 4MAT, Université Libre de Bruxelles, 50 avenue F. D. Roosevelt, 1050 Brussels, Belgium & Chimie des Interactions Plasma-Surface (ChIPS), CIRMAP, Université de Mons, 23 Place du Parc, 7000 Mons, Belgium (e-mail: babak.sadeghi@ulb.be).

M. P. Delplancke is with the 4MAT, Université Libre de Bruxelles, 50 avenue F. D. Roosevelt, 1050 Brussels, Belgium (e-mail: Marie-Paule.Delplancke@ulb.be).

R. Snyders is with the Chimie des Interactions Plasma-Surface (ChIPS), CIRMAP, Université de Mons, 23 Place du Parc, 7000 Mons, Belgium & Materia Nova Research Center, Parc Initialis, 7000 Mons, Belgium (e-mail: Rony.SNYDERS@umons.ac.be).

Functionalizing Gold Nanostars with Ninyhydrin as Vehicle Molecule for Biomedical Applications

Swati Mishra^{1*}

Senior Research Fellow

¹Department of Biological Sciences and Bioengineering, IIT Kanpur, India- 208016

*mswati547@gmail.com

Abstract-

In recent years, there has been an explosion in Gold Nano Particle (GNP) research, with a rapid increase in publications in diverse fields, including imaging, bioengineering, and molecular biology. GNPs exhibit unique physicochemical properties, including surface plasmon resonance (SPR) and bind amine and thiol groups, allowing surface modification and use in biomedical applications. Nanoparticle functionalization is the subject of intense research at present, with rapid progress being made towards developing biocompatible, multi-functional particles. In the present study, the photochemical method has been done to functionalize various-shaped GNPs like nanostars by the molecules like ninhydrin. Ninhydrin is bactericidal, virucidal, fungicidal, antigen-antibody reactive, and used in fingerprint technology in forensics. The GNPs functionalized with ninhydrin efficiently will bind to the amino acids on the target protein, which is of eminent importance during the pandemic, especially where long-term treatments of COVID- 19 bring many side effects of the drugs. The photochemical method is adopted as it provides low thermal load, selective reactivity, selective activation, and controlled radiation in time, space, and energy.

The GNPs exhibit their characteristic spectrum, but a distinctly blue or redshift in the peak will be observed after UV irradiation, ensuring efficient ninhydrin binding. Now, the bound ninhydrin in the GNP carrier, upon chemically reacting with any amino acid, will lead to the formation of Rhumann purple. A common method of GNP production includes citrate reduction of Au [III] derivatives such as aurochloric acid (HAuCl_4) in water to Au [0] through a one-step synthesis of size-tunable GNPs. The following reagents are prepared to validate the approach.

Reagent A solution 1 is 0.0175 grams ninhydrin in 5 ml Millipore water

Reagent B 30 μl of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ in 3 ml of solution 1

Reagent C 1 μl of gold nanostars in 3 ml of solution 1

Reagent D 6 μl of cetrimonium bromide (CTAB) in 3 ml of solution1

Reagent E 1 μl of gold nanostars in 3 ml of ethanol

Reagent F 30 μl of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ in 3 ml of ethanol

Reagent G 30 μl of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ in 3 ml of solution 2

Reagent H solution 2 is 0.0087 grams ninhydrin in 5 ml Millipore water

Reagent I 30 μl of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ in 3 ml of water

The reagents were irradiated at 254 nm for 15 minutes followed by their UV Visible spectroscopy. The wavelength was selected based on the one reported for excitation of a similar molecule Pthalimide. It was observed that the

solution B and G deviate around 600 nm, while C peaks distinctively at 567.25 nm and 983.9 nm. Though, it is tough to say about the chemical reaction happening, but ATR-FTIR of reagents will ensure that ninhydrin is not forming Rhumann purple in the absence of amino acids. Therefore, these experiments we achieved the functionalization of gold nanostars with ninhydrin corroborated by the deviation in the spectrum obtained in a mixture of GNPs and ninhydrin irradiated with UV light. It prepares them as a carrier molecule to take up amino acids for targeted delivery or germicidal action.

Current Design Approach for Seismic Resistant Automated Rack Supported Warehouses: Strong Points and Critical Aspects

A. Natali, F. Morelli, W. Salvatore

Abstract — Automated Rack Supported Warehouses (ARSWs) are structures currently designed as steel racks. Even if there are common characteristics, there are differences that don't allow to adopt the same design approach. Aiming to highlight the factors influencing the design and the behavior of ARSWs, a set of 5 structures designed by 5 European companies specialized in this field is used to perform both a critical analysis of the design approaches and the assessment of the seismic performance, which is used to point out the criticalities and the necessity of a new design philosophy.

Keywords — Steel racks, Automated Rack Supported Warehouse, thin walled cold-formed elements, seismic assessment.

A. Natali is a PhD at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (phone: 0039-0502218246; e-mail: agnese.natali@ing.unipi.it).

F. Morelli is a researcher at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (e-mail: francesco.morelli@ing.unipi.it).

W. Salvatore is a Full Professor at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (e-mail: walter@ing.unipi.it).

High Strength Steel Thin-Walled Cold-Formed Profiles Manufactured for Automated Rack Supported Warehouses

A. Natali, F.V. Lippi, F. Morelli, W. Salvatore, J. H. M. De Paula Filho, P. Pol

Abstract — Automated Rack Supported Warehouses (ARSWs) are storage buildings whose load-bearing structure is made of the same steel racks where goods are stocked. These racks are made of cold formed elements, and the main supporting structure is repeated several times along the length of the building, resulting in a huge quantity of steel. The possibility of using high strength steel to manufacture the traditional cold-formed profiles used for ARSWs is numerically investigated, with the aim of reducing the necessary steel quantity but guaranteeing optimal structural performance levels.

Keywords — Steel racks, Automated Rack Supported Warehouse, thin-walled cold-formed elements, high strength steel, structural optimization.

A. Natali is a PhD at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (phone: 0039-0502218246; e-mail: agnese.natali@ing.unipi.it).

F. V. Lippi is a Civil Engineering working at S.I.T.A. S.R.L., Pisa, Italy (e-mail: strutture@sitaingegneria.it).

F. Morelli is a researcher at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (e-mail: francesco.morelli@ing.unipi.it).

W. Salvatore is a Full Professor at the Department of Civil and Industrial Engineering of the University of Pisa, Pisa, Italy (e-mail: walter@ing.unipi.it).

J. H. M. de Paula Filho is a research engineer working for ArcelorMittal Global R&D, (e-mail: Jose.Matias-de-Paula@arcelormittal.com).

P. Pol is an Industry Steel Solutions Manager working for ArcelorMittal R&D (e-mail: patrick.pol@arcelormittal.com).

Acoustic Characterization of labiovelarized Berber Consonants

Falek Leila

Abstract— Labiovelarization of velar consonants and labials [1] is a very widespread phenomenon. It is attested in all the major northern Berber dialects. Only the Tuareg is totally unaware of it. But, even within the large Berber-speaking regions of the north, it is very unstable: it may be completely absent in certain dialects (such as the Bougie region in Kabylie), and its extension and frequency can vary appreciably between the dialects which know it. Some dialects of Great Kabylia or the Chleuh domain, for example, "labiovelarize" more than others from the same region. Thus, in Great Kabylia, the adjective "large" will be pronounced: amqqwran with the At Yiraten and amqqrān with the At Yanni, a few kilometers away. One of the problems with them is deciding whether it is one or two phonemes. All the criteria used by linguists in this kind of case lead to the conclusion that they are unique phonemes (a phoneme and not a succession of two phonemes, / k + w /, for example). The phonetic and phonological criteria are moreover clearly confirmed by the morphological data since in the system of verbal alternations, these complex segments are treated as single phonemes: agwem, "to draw, to fetch water," akwer, "to fly" have exactly the same morphology as asem "jealous", arem "taste", ames, "dirty" or afeg, "steal" ... verbs with two radical consonants (type aCC). At the level of notation, both scientific and usual, it is, therefore, necessary to represent the labiovelarized by a single letter, possibly accompanied by a diacritic.

in fact, actual practices are diverse. - The scientific representation of type does not seem adequate for current use because its realization is easy only on a microcomputer. - The Berber Documentation File used a small ° (of n °) above the writing line: k °, g ° ... which has the advantage of being easy to achieve since it is part of general typographical conventions in Latin script and that it is present on a typewriter keyboard. - Mouloud Mammeri, then the Berber Study Group of Vincennes (Tisuraf review), and a majority of Kabyle practitioners over the last twenty years have used the succession "consonant +" semi-vowel / w / "(CW) on the same line of writing; for all the reasons explained previously, this practice is not a good solution and should be abandoned, especially as it particularizes Kabyle in the Berber ensemble We will therefore retain the "°" by expounding, above the writing line, which poses no problem of practical realization: g °, k ° ... We will write: iregg ° el, akk ° ... When possible (special fonts on microcomputer), it is also possible to place the small ° directly on the letter. In this study, we were interested in two velar consonants / g / and / k / labiovelarized: / gw / and the / kw / (we adopted the addition of the "w") for the representation

for ease of writing in graphical mode. It is a question of trying to characterize these four consonants in order to see if they have different places of articulation so if they are distinct (if these velars are distinct from their labiovelarized counterpart). This characterization is done using locus equations.

Keywords— labiovelarization, berber consonants, locus equations, berber dialect, kabyl language

Falek Leila is with the in University of Science and Technology Houari Boumediene, Algeria (e-mail: falek.leila@gmail.com).

Twice-Over Object Detection Methodology: Forced Humanization for Explainability of Artificial Intelligence

Sarah Reynolds, Brian Butka

Abstract— Artificial intelligence is playing an increasingly large role in public life. What once was reserved for top-of-the-line products is now accepted as basic functionality. With the increased consumption of products that rely on artificial intelligence, there is increased skepticism from the user both in the public and private sectors. Humans tend to be wary of the decision-making process used in machine learning models, which leads to a need to move toward explainability in artificial intelligence products. This paper outlines an approach to explainability that forces object detection to mimic human decision making and logic. This approach is two steps. The first is that object detection is performed using a neural network model, without any attempt at explainability. A second model is used to reinforce decisions made by the neural network after breaking down the image of an object into recognizable sub-components. In this paper, vehicles are recognized, and then analyzed for the presence of sub-components such as wheels, windshields, and mirrors. The presence of these subcomponents are fed into the second model, via a numerical representation that allows the model to decide whether the detected object is actually a vehicle. If the model verifies that a vehicle is present, it can provide the sub-components recognized as justification for the decision. This allows the system to provide recognizable logic to a human user. Each image is now processed twice, in an initial detection stage and in a verification phase. This verification phase has multiple benefits, outside of explainability. It turns out that this system is more accurate overall, but more importantly provides a line of defense against adversarial images. This increased performance, coupled with explainable artificial intelligence, makes this system more adaptable to a number of projects where both security and trust are of concern to the user.

Keywords— Explainability, image processing, neural networks, object detection

Sarah Reynolds is with the Department of Electrical Engineering and Computer Science, Embry Riddle Aeronautical University, Daytona Beach, FL 32114 USA (phone: 386-451-6034; e-mail: reynos23@my.erau.edu).

Brian Butka is with the Department of Electrical Engineering and Computer Science, Embry Riddle Aeronautical University, Daytona Beach, FL 32114 USA.

Memory Forensics Tools Quantification and Ranking

Olaide Afolabi, Faith Adegbenro, Prudence Philips, Grace Owolabi

EECS Department

Howard University

Washington DC, USA

{olaide.afolabi,faith.adegbenro,prudence.philips,grace.owolabi}@bison.howard.edu

Hassan Salmani

EECS Department

Howard University

Washington DC, USA

hassan.salmani@howard.edu

Stanley L. Harris Jr, Bevan Ngo, George A. Jarvis

Lockheed Martin

Abstract—Our data is stored in the memory of computer devices we use in daily operations. While our computer devices, such as computer desktops, server machines, and sensor nodes, are accessible by unknown parties in today’s connected world, memory forensics is a key in identifying and investigating cyberattacks. Memory Forensics refers to the analysis of volatile data in a computer’s main memory dump. The decision to be made is whether to use a dedicated memory forensics tool versus a full suite security solution that provides memory forensics capabilities. And also, the decision of whether to use commercial software or open-source tools is to be made depending on the customer’s security needs. With the vast array of tools available on the market, the best way to make decisions and recommendations is to carry out a trade-study analysis. This paper presents an approach to quantify and rank forensics tools. We first identify features for requirements and capabilities of forensics tools. In the following, we show how to perform the quantification and ranking of forensics tools based on their feature converge. The results indicate a user can easily and effectively evaluate a forensics tool and compare it against its counterparts; making an informed decision in acquiring forensics tools.

Index Terms—memory forensics, NIST, forensics tools ranking, requirements and capabilities.

I. INTRODUCTION

Memory forensics is performed to detect and investigate attacks or malicious behaviors that cannot be easily detected by analyzing hard drive data [1]. Volatile data exists when a computer turns on and it is operating, and the data reside in the main memory of a computer while it is running. Volatile data depend on power and become lost when a computer is powered off. Volatile data may include information about browsing history, chat messages, and clipboard contents [2] [3] which can reveal details about the execution status of various programs in a computer.

A memory dump (also known as a core dump or system dump) is a snapshot of computer main memory at a specific time. A memory dump consists of the state of computer programs running on a computer system. Memory dumps contain random access memory (RAM) data that can host valuable forensics data that can be used to determine the cause of a security compromise with its details on what and how it has happened [4] [5].

Some attacks directly upload malware to memory locations without manipulation hard disk data. As a result, the most sophisticated enterprise security systems are equipped with

memory forensics and behavioral analysis capabilities to identify malware, rootkits, and zero days by analyzing the volatile memory of a computer system [6] [7].

Through studying memory dumps, memory forensics can reveal run-time system activities such as open network connections, recently executed commands or processes, and opened files. Memory forensics is a critical tool in response to sophisticated attacks as any program either malicious or otherwise must be loaded in memory. For sophisticated attacks and threats, critical forensics data will exist solely in system main memory that includes network connections, account credentials, encryption/decryption keys, running processes, handles, and internet history which is non-cacheable [8] [9].

As attack vectors and methods become increasingly complicated, there is a high demand for memory forensics tools and skills to protect enterprise environments. Commonly used network-based security solutions like firewalls and antivirus tools are incapable of detecting file-less malware written directly into a computer’s main memory. Therefore, incident response teams should give particular attention to memory forensics tools to make sure business intelligence and data are protected against stealthy attacks such as file-less, in-memory malware, or RAM scrapers [10] [11].

Finding the correct forensics tools that will support the operational environment is a challenge. There has been some study comparing forensics tools such as [12] [13]; however, no work has introduced a quantitative approach to rank forensics tools. To address the challenge, the paper presents a novel approach for ranking forensics tools based on the quantification of their requirements and capabilities coverage. We propose a methodology for quantifying qualitative objectives identified by The National Institute of Standards and Technology (NIST) and users and practitioners. Quantification further enables to compare and rank forensics tools. As a result, a user can make an informed quantitative decision in acquiring forensics tools.

The rest of this paper is organized as follows. Section II discusses the requirements and capabilities of forensics tools. The following Section III presents a novel approach to quantify the requirements and capabilities of a forensics tool accompanied with some results. Finally, Section V concludes the paper.

II. REQUIREMENTS AND CAPABILITIES FOR FORENSICS TOOLS

A process model is a methodology used to conduct an investigation in digital forensics; a framework with several phases to guide an investigation [14]. Different process models have been introduced for digital forensics, and they mainly include the following eight distinctive steps and features [15]

- 1) **Search authority** - Legal authority is required to conduct a search and/or seizure of data.
- 2) **Chain of custody** – In legal cases, chronological documentation of access and handling of evidentiary items is essential to avoid claims for evidence tampering or misconduct.
- 3) **Imaging/hashing function** - When items comprising possible digital evidence are discovered, each item should be carefully copied and then hashed to confirm the integrity of the copy.
- 4) **Validated tools** - When possible, tools used for forensics should be validated to ensure reliability and correctness.
- 5) **Analysis** - Forensic analysis is the execution of investigative and analytical techniques to examine, analyze, and interpret the evidentiary artifacts retrieved.
- 6) **Repeatability and reproducibility (quality assurance)**
 - a forensic analyst should be able to repeat the procedures of forensic analysis and be able to reproduce same outcomes [16].
- 7) **Reporting** - The forensic analyst must document his or her analytical procedure and conclusions for use by others.
- 8) **Presentation** - In most cases, the forensic analyst will present his or her findings and conclusions to a court or other audience.

NIST [17] has suggested some criteria as a fundamental set of requirements for forensics tools, and should be considered when a choice of tools is available:

- **Usability** – The ability to present data in a form that is useful to an investigator
- **Comprehensive** – The ability to present all data to an investigator so that both inculpatory and exculpatory evidence can be identified
- **Accuracy** – The quality of the output of the tool has been verified
- **Deterministic** – The ability for the tool to produce the same output when given the same set of instructions and input data
- **Verifiable** – The ability to ensure accuracy of the output by having access to intermediate translation and presentation results
- **Tested** – The ability to determine if known data present within the internal memory of a computer device is not modified and reported accurately by the tool

In addition to the aforementioned requirements for forensics tools established by NIST, researchers, practitioners, and

developers have highlighted a number of capabilities for forensics tools [18] [19] [20] [21] [22] [23] [24]:

- **Level of Interference** - The tool's processes should have minimal interference with the data collected.
- **Speed** - The ability of the tool to get the snapshot as quickly as possible.
- **Snapshot Consistency** - The ability of the acquisition tool to faithfully mirror the memory state of a target machine at a given instance of time.
- **Tamper Resistance** - The ability of a tool or mechanism to not be infected by malware present in the OS.
- **Performance Isolation** - The ability of the tool to have only minimal impact on the performance of the other applications or processes that may be executing on the system.
- **Live Capturing** - The ability of the tool to capture the memory when other applications are executing.

III. FORENSICS TOOLS QUANTIFICATION

The Computer Forensics Tool Testing (CFTT) program at NIST [25] is a project in The Software Diagnostics and Conformance Testing Division supported by The Office of Law Enforcement Standards. The CFTT program evaluated a number of forensics tools under 13 different categories: Binary image (JTAG, chip-off) decoding and analysis tools, Deleted file recovery and active file listing, Digital data acquisition, Disk imaging, Forensic media preparation, Graphic file carving, Hardware write block, Mobile device acquisition, String search tool, Software write block, Video file carving, Write protected drive, and Windows registry forensics tool.

Several forensics tools are evaluated by NIST in each category. For example, 13 different forensics tools such as Autopsy 4.13.0 by Basis Technology, Oxygen Forensic Detective v13.1.0.43, FTK v7.2 by Exterro, and X-Ways v19.8 SR-7 by X-Ways Software Technology, are evaluated for Binary image (JTAG, chip-off) decoding and analysis tools category. A comprehensive report for each tool is generated, and the report typically includes four major parts: (1) identifying and providing a summary of any significant anomalies observed in the test runs, (2) identifying test cases selected for testing, (3) identifying testing environment that includes hardware, software and support environment, and (4) providing an overview of the test case results reported by the tool.

While each report provides detailed analyses for one forensics tool in a specific category, no comparison between forensics tools is provided. Furthermore, no quantitative measure is suggested to facilitate the ranking of forensics tools. As a result, a user might not be able to compare various forensics tools in a specific category or across different categories. A quantitative comparison between forensics tools would considerably help users to make sound planning in acquiring forensics tools based on their demands.

To enable quantitative comparisons of forensics tools, we study each forensics tool by referring to their user manuals, scientific papers, NIST reports. In some cases, we even examine some versions of forensics tools that have not been examined.

TABLE I
REQUIREMENTS AND CAPABILITIES FOR DIGITAL DATA ACQUISITION
FORENSICS TOOLS.

Requirements and Capabilities	Description
Usability	(C1) The tool shall be able to acquire digital source using each access interface visible to the tool; (C2) The tool shall be able to create either a clone of a digital source or an image of a digital source or provide the capability for the user to select and then create either a clone or an image of a digital source; (C3) The tool shall operate in at least one execution environment and shall be able to acquire digital sources in each execution environment; (O1) Create an image file in a specified format either by default or selected from a list of supported formats; (O2) Create a multi-file image across multiple destination devices; (O3) Create a clone of a subset of an image file; (O4) Create a clone from the digital source; (O5) Create a clone from an image file; (O6) Create an unaligned clone or Create a cylinder-aligned clone; (O7) Support forensic workstation and suspect machine OSs; (O8) Not require installation on the suspect machine; (O9) Run on kernel mode not the user mode; (O10) Be able to save the captured RAM on a removable media; (O12) Capture the memory image in a reasonably small file; (O13) Save the captured image in a file type that is readable by the selected RAM analysis tool; (O14) Be open-source/proprietary.
Comprehensive	(C1) The tool shall completely acquire all visible data sectors from the digital source; (C2) If there are unresolved errors in reading from a digital source, then the tool shall use a benign to fill in the destination object in place of the inaccessible data.
Accuracy	(C1) All data sectors acquired by the tool from the digital source shall be accurately acquired; (C2) If there are unresolved errors reading from a digital source, then the tool shall notify the user of the error type and the error location; (O1) Check the integrity of an image file by detecting if the image file has changed since the image file was created.
Deterministic	
Verifiable	(C1) If there are unresolved errors reading from a digital source, then the tool shall notify the user of the error type and the error location; (C2) If there are unresolved errors reading from a digital source, then the tool shall use a benign fill in the destination object in place of the inaccessible data.
Tested	
Level of Interference	(C1) If there are unresolved errors reading from a digital source, then the tool shall use a benign fill in the destination object in place of the inaccessible data.
Speed	
Snapshot Consistency	
Tamper Resistance	
Performance Isolation	
Live Capturing	(C1) The tool shall be able to create either a clone of a digital source or an image of a digital source or provide the capability for the user to select and then create either a clone or an image of a digital source.

ined by NIST yet. Afterward, we identify core and optional features for requirements and capabilities in each category. For example, Table I presents the detailed features for the requirements and capabilities of forensics tools for digital data acquisition. We have identified 4 core and 14 optional features for the Usability requirement. Or, we have identified only 1 core feature for the Live Capturing capability. Table I also highlights that some requirements and capabilities, such as the Deterministic requirement, and the Tamper Resistance capability, have no feature under the Digital Data Acquisition category. We have developed a table similar to Table I for every 13 categories identified by the CFTT program.

After identifying the core and optional features for each capability and requirement under each category, we examine forensics tools to determine what features each of them covers. In total, we have examined 81 forensics tools considering their different versions. Determining the features enables us to quantify the requirements and capabilities of a forensics tool based on the features covered. While we have examined 23 forensics tools for the digital data acquisition tool category, Table II only shows the results of examining three forensics tools for the digital data acquisition tool category: EnCase v7.12.01.18, Paladin v4.0, and Tableau TD3 Forensic Imager v1.3.0.

Table II indicates that the EnCase forensics tool covers 3 core features and 0 optional features related to the Usability requirement as identified in Table I. Meantime, the Paladin and Tableau forensics tools cover 3 core and 5 optional features. It should be noted that Paladin and Tableau cover different optional features. To quantify a requirement/capability, we give the same weight to its core and optional features and quantify as follow if both core and optional features are identified for the requirement/capability:

$$Q = \frac{CC + OC}{CT + OT} \quad (1)$$

where

CC = the number of core features covered

CT = the total number of core features

OC = the number of optional features covered

OT = the total number of optional features

As shown in Table II, the Usability requirement for Encase is quantified as 0.5 since it covers all three core features but none of the optional features. On the other hand, both Paladin and Tableau are quantified as 0.67 since they cover 5 out of 14 optional features in addition to all core features.

If only core features for a requirement/capability are identified, it is quantified as follows:

$$Q = \frac{CC}{CT} \quad (2)$$

where

CC = the number of core features covered

CT = the total number of core features

TABLE II
FORENSICS TOOLS FEATURES AND QUANTIFICATION FOR THE DIGITAL DATA ACQUISITION TOOL CATEGORY.

Requirements & Capabilities	EnCase v7.12.01.18		Paladin v4.0		Tableau TD3 Forensic Imager v1.3.0	
	Features	Quantification	Features	Quantification	Features	Quantification
Usability	C1,C2,C3	$=(3/3+0/14)/2=0.5$	C1,C2,C3,O1,O3,O4,O5,O6	$=(3/3+5/14)/2=0.67$	C1,C2,C3,O1,O4,O6,O7,O8	$=(3/3+5/14)/2=0.67$
Comprehensive	C1	$=(1/2)=0.5$	C1,C2	$=(2/2)=1$	C1,C2	$=(2/2)=1$
Accuracy	C1,C2	$=(2/2+0/1)/2=0.5$	C1,C2	$=(2/2+0/1)/2=0.5$	C1,C2	$=(2/2+0/1)/2=0.5$
Deterministic						
Verifiable	C1	$=(1/2)=0.5$	C1,C2	$=(2/2)=1$	C1,C2	$=(2/2)=1$
Tested						
Level of Interference	-	$=(0/1)=0$	C1	$=(1/1)=1$	C1	$=(1/1)=1$
Speed						
Snapshot Consistency						
Tamper Resistance						
Performance Isolation						
Live Capturing	C1	$=(1/1)=1$	C1	$=(1/1)=1$	C1	$=(1/1)=1$

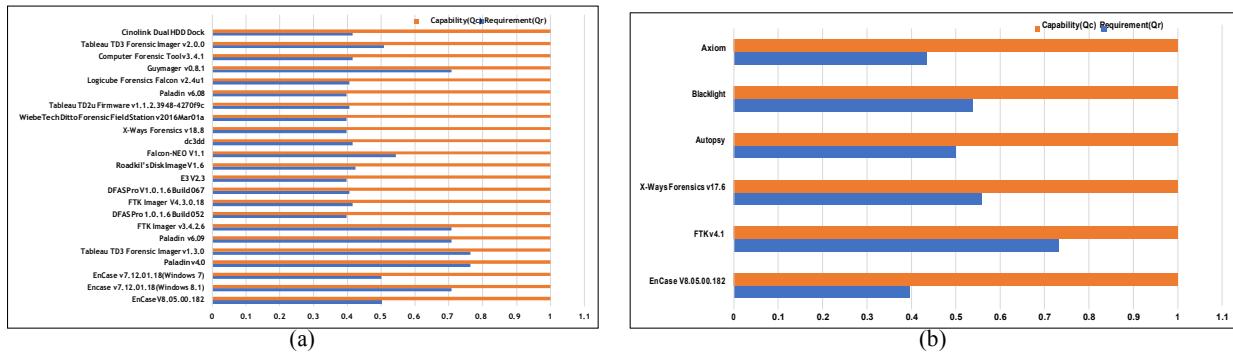


Fig. 1. The quantification of requirements and capabilities for (a) the digital data acquisition forensics tools, and (b) the string search forensics tools.

For example, the Verifiable requirement consists of two features, and EnCase covers only one feature, and Paladin and Tableau cover both features. As a result, EnCase is quantified as 0.5, and Paladin and Tableau are quantified as 1 in regard to the Verifiable requirement in the digital data acquisition tool category.

Finally, if no feature is not identified for a requirement/capability in a category, no forensics tool is quantified for the requirement/capability.

To have an overall quantification of requirements and capabilities for a forensics tool, we separately calculate the geometric mean of the set of requirements and the geometric mean of the set of capabilities. The geometric mean is considered as it indicates the central tendency of a set of numbers where each presents a different quality. The overall requirement of a forensics tool, referred to as Q_r , is quantified as

$$Q_r = \text{GeoMean}(Q_{\text{usability}}, Q_{\text{comprehensive}}, Q_{\text{accuracy}}, Q_{\text{deterministic}}, Q_{\text{verifiable}}, Q_{\text{tested}}) \quad (3)$$

In a similar manner, the overall capability of a forensics tool, referred to as Q_c , is quantified as

$$Q_c = \text{GeoMean}(Q_{\text{LevelOfInterference}}, Q_{\text{Speed}}, Q_{\text{SnapshotConsistency}}, Q_{\text{TamperResistance}}, Q_{\text{PerformanceIsolation}}, Q_{\text{LiveCapturing}}) \quad (4)$$

Figure 1 (a) presents the quantification of requirements (Q_r) and capabilities (Q_c) for 23 digital data acquisition forensics tools considering different versions of some forensics tools. Our study shows that all forensics tools present Q_c equal to 1. On the other hand, the forensics tools present different Q_r . Paladin and Tableau TD3 Forensic Imager present the highest Q_r , that is the requirement coverage, with about 0.76. However, DFAS Pro, E3, X-Ways Forensics, and WiebeTech present the lowest Q_r with about 0.39. Figure 1 (b) presents similar results for the string search for 6 forensics tools. The results show that FTK outperforms other forensics tools in terms of Q_r by the value of 0.73, while all forensics tools present Q_c equal to 1. The results in Figure 1 enable users to make an informed decision about acquiring forensics tools.

IV. FORENSICS TOOLS RANKING

Quantifying the requirement and capability of forensics tools also enables cross-comparison of forensics tools over

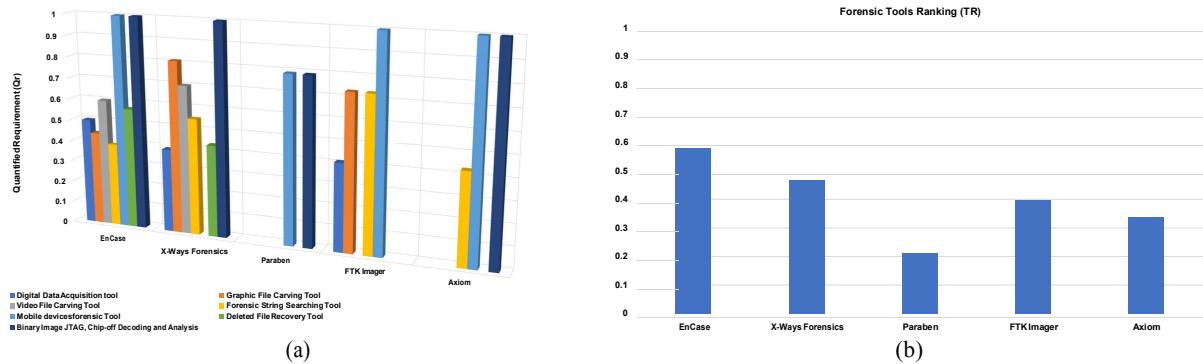


Fig. 2. (a) Comparison of some forensics tools in few categories based on their quantified requirement (Qr), (b) the overall ranking of forensics tools.

various forensic categories. Figure 2(a) presents a sample comparison between Encase, X-Ways Forensics, Paraben, FTK Imager, Axiom forensics tools based on their quantified requirements under the following categories: Digital Data Acquisition, Graphic File Carving, Video File Carving, Forensic String Searching, Mobile devices forensic, Deleted File Recovery, and Binary Image JTAG, Chip-off Decoding and Analysis. Based on existing data, Figure 2(a) shows that EnCase forensics tool covers all examined categories, and X-Ways Forensics comes next. Figure 2(a) does not indicate a specific version of tools as we have combined data from different versions of a tool to have more comprehensive coverage of the categories.

It is possible to present the overall ranking of forensics tools (TR) based on their Qr in different categories. We consider the number of categories and Qr of each category for a forensics tool to determine its ranking as follows:

$$TR = \text{Average} \left(\frac{N_{ReqCovCats}}{N_{ReqCats}} \times \text{GeoMean}(Qr \text{ of } RqCovCats), \frac{N_{CapCovCats}}{N_{CapCats}} \times \text{GeoMean}(Qc \text{ of } CapCovCats) \right) \quad (5)$$

where

$N_{ReqCovCats}$ = the number of covered categories in requirements

$N_{ReqCats}$ = the total number of requirements categories

$\text{GeoMean}(Qr \text{ of } ReqCovCats)$ = Geometric mean of Qrs of covered requirement categories.

$N_{CapCovCats}$ = the number of covered categories in capabilities

$N_{CapCats}$ = the total number of capabilities categories

$\text{GeoMean}(Qc \text{ of } CapCovCats)$ = Geometric mean of Qcs of covered capability categories.

For example, Paraben forensics tool covers two categories, Mobile devices forensic and Binary Image JTAG Chip-off Decoding and Analysis, out of 7 categories both with Qr and

Qc equal to 0.79 and 0.7, respectively. Therefore,

$$TR = \text{Average} \left(\frac{2}{7} \times \text{GeoMean}(0.79, 0.79) \right)$$

$$\frac{2}{7} \times \text{GeoMean}(0.7, 0.7) = 0.21$$

Figure 2(b) presents the ranking of studied forensics tools. The results show that EnCase obtains the highest ranking with TR equal to 0.6. Figure 2 provides users a quantitative measure to compare different forensics tools in detail. The results even further help developers by highlighting the strengths and shortcomings of their tools so that they can address the weakness of their products.

V. CONCLUSIONS

Memory forensics plays a key role in identifying and investigating cyberattacks. There are a number of open sources and commercial memory forensics tools to choose from. The paper presented a novel approach to quantify and rank memory forensics tools.

We first determined the requirements and capabilities of forensics tools. Features for each requirement and capability were then identified. A forensics tool under study was then examined against the requirements and capabilities and covered features were marked. In the following, we showed a method to quantify a requirement and a capability. The method was extended to quantify a set of requirements and capabilities. Finally, we presented how to rank a forensics tool based on its quantified requirements and capabilities.

Our results highlighted that a user can effectively compare a forensics tool against its counterparts and identify its merits and shortcomings. Therefore, an informed and quantitative decision can be made.

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A Quinary Coding and Matrix Structure-based Channel Hopping Algorithm for Blind Rendezvous in Cognitive Radio Networks

Qinglin Liu¹, Zhiyong Lin^{1*}, Zongheng Wei¹, Jianfeng Wen¹, Congming Yi¹, Hai Liu²

¹School of Computer Science, Guangdong Polytechnic Normal University, Guangzhou, China

Email: lql6315@163.com, zhiyong.lin@qq.com, {zhwei, wenjf}@gปnu.edu.cn, cm_yi@foxmail.com

²Department of Computing, The Hang Seng University of Hong Kong, Hong Kong, China

Email: hliu@hsu.edu.hk

*Corresponding Author: Zhiyong Lin, Email: zhiyong.lin@qq.com

Abstract—The multi-channel blind rendezvous problem in distributed cognitive radio networks (DCRNs) refers to how users in the network can hop to the same channel at the same time slot without any prior knowledge (i.e., each user is unaware of other users' information). The channel hopping (CH) technique is a typical solution to this blind rendezvous problem. In this paper, we propose a quinary coding and matrix structure-based CH algorithm called QCMS-CH. The QCMS-CH algorithm can guarantee the rendezvous of users using only one cognitive radio in the scenario of the asynchronous clock (i.e., arbitrary time drift between the users), heterogeneous channels (i.e., the available channel sets of users are distinct), and symmetric role (i.e., all users play a same role). The QCMS-CH algorithm first represents a randomly selected channel (denoted by R) as a fixed-length quaternary number. Then it encodes the quaternary number into a quinary bootstrapping sequence according to a carefully designed quaternary-quinary coding table with the prefix "R00". Finally, it builds a CH matrix column by column according to the bootstrapping sequence and six different types of elaborately generated subsequences. The user can access the CH matrix row by row and accordingly perform its channel hopping to attempt to rendezvous with other users. We prove the correctness of QCMS-CH and derive an upper bound on its Maximum Time-to-Rendezvous (MTTR). Simulation results show that the QCMS-CH algorithm outperforms the state-of-the-art in terms of the MTTR and the Expected Time-to-Rendezvous (ETTR).

Keywords—channel hopping, blind rendezvous, cognitive radio networks, quaternary-quinary coding.

I. INTRODUCTION

IN recent years, due to the rapidly growth of wireless devices, the problem of spectrum scarcity has become more and more serious. Existing studies have shown that many licensed spectrum bands are underutilized [1]. Therefore, cognitive radio technique came into being, which can make more efficient and better use of the precious spectrum band. In distributed cognitive radio networks (DCRNs), there are a set of channels with different frequencies and two types of spectrum users, i.e., primary users (PUs) and secondary users (SUs). PUs have the priority to use the licensed channels, and SUs can only utilize those channels that are not currently occupied by PUs [2]. At any moment, the channels which can be used by SUs are called available channels. If two or more

SUs in a proximity need to communicate with each other, they must hop to and access the same available channel at the same time to set up a communication link. In this paper, we study the problem of how to set up an initial communication link between SUs in DCRNs.

For convenience, we refer to SUs as users. In addition, we assume that time is divided into slots of fixed-length. In DCRNs, if the users are unaware of each other's available channels and local clocks, and have no pre-assigned channel hopping (CH) strategies, it is hard to guarantee the users to hop to the same channel at the same time slot (i.e., set up a communication link). This challenging problem is referred to as the multi-channel blind rendezvous problem (or the rendezvous problem for short) [3], [4]. A number of works have been proposed on how to design CH sequences for blind rendezvous in DCRNs. The desirable CH algorithms should require as few prerequisites as possible. For example, it is not preferable to assume time-synchronization of network, multiple radios at each SU, different roles of SUs, and even availability of user IDs. Meanwhile, the CH algorithms are expected to give good performance in terms of the maximum time-to-rendezvous (MTTR) (i.e., the users are guaranteed to achieve rendezvous in a bounded time in the worst case), as well as the average time-to-rendezvous (i.e., Expected TTR (ETTR)).

In this paper, we propose a novel approach of generating CH sequences, named QCMS-CH (short for Quinary Coding and Matrix Structure based Channel Hopping), to solve the rendezvous problem. The CH sequence generated by the QCMS-CH algorithm can be represented by a matrix (CH matrix). Specifically, in QCMS-CH, each user first randomly selects an available channel and transforms its index (denoted by R) into a fixed-length quaternary number, then uses a carefully designed quaternary-quinary coding table to convert the quaternary number into a quinary number. Then, the user adds the prefix "R00" in front of the quinary number to construct a bootstrapping sequence. The length of this bootstrapping sequence determines the number of columns of the CH matrix, and each element of

the bootstrapping sequence, which may be one of $\{R, 0, 1, 2, 3, 4\}$, corresponds to a column of the CH matrix. Next, the CH matrix is built column by column. Since there are only six different types of columns, i.e., R-type and λ -type ($\lambda \in \{0, 1, \dots, 4\}$), six types of subsequences associated with R-type and λ -type can be elaborately constructed based on the available channels of the user. With the construction of subsequences, the CH matrix can be eventually built by repeating the corresponding subsequence in each column, e.g., a 0-type subsequence is repeated in a column associated with 0, and a 1-type subsequence is repeated in a column associated with 1, etc. Once the CH matrix is built, the user can access the matrix row by row and accordingly perform its channel hopping to attempt rendezvous with other users.

The main contributions of this paper are summarized as follows:

1) The proposed QCMS-CH algorithm solves the blind rendezvous problem in general scenario because it is applicable to single-radio at each user, asynchronous clocks, heterogeneous available channels, and symmetric roles among the users. Moreover, QCMS-CH depends on only the available channels of user and does not need using user ID.

2) To the best of our knowledge, compared with existing similar algorithms [5]-[9] which construct the bootstrapping sequences based on the binary representation of the randomly selected channel, QCMS-CH is the first one that directly uses the quaternary representation of the channel and further adopts the efficient quaternary-quinary coding to generate the bootstrapping sequence with shorter length. Given the number of potential available channels N , the bootstrapping sequence generated by QCMS-CH has length of $L=2\times\lceil\log_4 N\rceil/2\rceil+3$, which does not exceed 9 when $N\leq 1024$. Thanks to the shorter bootstrapping sequence and the elaborately constructed different types of subsequences, QCMS-CH provides very competitive theoretical performance with the MTTR upper-bounded by $\max\{(P_A+4)(P_B+6), (P_B+4)(P_A+6)\}\times L$, where P_A and P_B are the smallest prime number not less than the number of available channels of user A and user B , respectively.

3) We conduct extensive simulations to verify the effectiveness of the QCMS-CH algorithm. Compared with several most recent representative algorithms, QCMS-CH performs better in terms of both MTTR and ETTR. According to the simulation results, QCMS-CH can save more than 5% of the average TTR than the state-of-the-art in many cases.

The rest of this paper is organized as follows. In Section II, we review related works. In Section III, we propose the system model and the formulation of the problem. In Section IV, we describe the QCMS-CH algorithm in details. In Section V, we present extensive simulation results. We conclude this paper in the Section VI.

II. RELATED WORKS

In cognitive radio networks, rendezvous is a prerequisite for communication between users. The traditional solution is to use

the Common Control Channel (CCC) to achieve rendezvous. However, as the number of users increases, the CCC scheme suffers from congestion. In addition, CCC is vulnerable to external interference and malicious attacks [10]. Therefore, the rendezvous algorithms without CCC have attracted extensive attention of researchers. In this section, we briefly review some representative blind rendezvous algorithms, which are divided into different classes based on their assumptions.

Symmetric role/Asymmetric role: This classification is based on whether users can be divided into different roles. In the asymmetric algorithm (e.g. [11], [12] and [13]), the users are divided into senders and receivers, and generate different CH sequences according to different roles. In the symmetric algorithm (e.g. [14] and [15]), the users are all in the same role, so their CH sequences are generated according to the same strategy. In DCRNs, all users are equal and no roles are preassigned to each user before they complete the rendezvous. Therefore, the CH algorithm with symmetric roles is more widely used in DCRNs.

Homogeneous channels/Heterogeneous channels: If the available channel sets of two users are exactly the same, it is called a homogeneous model; otherwise, it is called a heterogeneous model. In reality, if two users are geographically close, they are likely to have the same set of available channels; if two users are far apart, they tend to have different sets of available channels. The early works, say [16] and [14], consider both of these two models. However, since the homogeneous mode can be viewed as a special case of the heterogeneous model, and the latter is more practical, most of recent research has placed focus on the heterogeneous model.

Synchronous clock/Asynchronous clock: Synchronous clock algorithms (e.g., [17] and [18]) assume that all users can synchronize their time through a common time source (e.g., GPS), so their CH sequences can be started at the same time. However, in DCRNs, there may have no common time source for reference due to the hardware limitation, and it would be hard for the users to synchronize in many cases. Therefore, asynchronous algorithms (e.g., [6], [7] and [14]) are more general and practical in DCRNs.

Onymous ID/Anonymous ID: The onymous algorithm (e.g., [19], [20] and [21]) utilizes the user's unique identifier (ID) to generate their CH sequences. However, once the user's ID is exposed, the user would be vulnerable to external malicious attacks. Therefore, in the consideration of security, the anonymous algorithms without using user ID (e.g., [4], [6] and [14]) are more attractive than the onymous algorithms.

Single-radio/Multi-radio: A user can be equipped with multiple radio transceivers, so they can hop to multiple channels simultaneously at a time slot. The multi-radio algorithms (e.g., [5], [22] and [23]) can greatly reduce the time-to-rendezvous (TTR), meanwhile bearing the increase

of hardware cost. From the perspective of economic feasibility, the single-radio algorithms (e.g., [8], [9] and [14]) are more preferred than the multi-radio algorithms. However, it is also more challenging to design efficient rendezvous algorithms for users with single radio.

Global channel set/Local channel set: The early works, e.g., [14] and [16], generate the CH sequences based on the global channel set, i.e., the whole set of all potentially available channels. However, in reality, the channels actually available to a user usually take up a small portion of the whole channel set. The CH sequences generated based on the whole channel set may consist of many unavailable channels, and thus usually have much large length and TTR. More recently, researchers have pay increasing intention to the design of CH sequences based on the local channel set (i.e., only the channels available to each user) for better efficiency [5]-[9], [24], although this direction is more challenging than that based on the global channel set.

In this paper, we mainly study the construction of CH sequences for efficient blind rendezvous of users in DCRNs under a general scenario by consideration of symmetric role, heterogeneous channels, asynchronous clock, anonymous ID, single-radio, and local channel set.

III. SYSTEM MODEL AND PROBLEM FORMULATION

A. System Model

We assume that a DCRN consists of N non-overlapping channels with universal indices from 1 to N and M ($M \geq 2$) users. Each user is equipped with one cognitive radio transceiver, with which the user can sense the state of any channel and switch between the perceived idle channels (i.e., its available channels). We use $\mathcal{C} = \{1, 2, \dots, N\}$ and \mathcal{U} to denote the set of channels (or more precisely, channel indices) and the set of users, respectively. We use \mathcal{C}_A ($\mathcal{C}_A \subseteq \mathcal{C}$, $\mathcal{C}_A \neq \emptyset$) to denote the set of channels available to user A ($A \in \mathcal{U}$), and $|\mathcal{C}_A|$ is the cardinality of \mathcal{C}_A . We assume that there is at least one common available channel between any two users, that is, for $\forall A, B \in \mathcal{U}$, $G_{AB} = |\mathcal{C}_A \cap \mathcal{C}_B| \geq 1$.

The network is time-slotted and each slot has a length of 2Δ , where Δ represents the duration required for message exchange and link establishment between two users when they rendezvous on a same channel. The value of Δ is usually set as 10 ms [14]. The reason for doubling the slot length is that, when the slots of two users are not aligned, it can still guarantee that there is at least Δ time overlap for accomplishing link establishment when the two users rendezvous on a same channel. Via such setting, the slots of any pair of users can be regarded as aligned for the design of CH sequences [14].

B. Problem Formulation

As most of existing relevant works, we focus on the two-user rendezvous problem. The rendezvous problem with more than two users can be solved by some extension of two-user rendezvous algorithms or specific design of multi-user

rendezvous algorithm [14], [25], which is beyond the scope of this paper. Let $S_A = \{S_A^1, S_A^2, \dots, S_A^{T_A}\}$ and $S_B = \{S_B^1, S_B^2, \dots, S_B^{T_B}\}$ denote the CH sequences of user A and user B , respectively, where T_A and T_B denote the period of the CH sequences of user A and user B , respectively. In the asynchronous clock scenario, we suppose user A starts its channel hopping with δ ($\delta \in \mathbb{N}$) slots earlier than user B . The blind rendezvous problem studied in this paper can be formulated as follows [9]:

$$\min t (t \in \mathbb{Z}^*), \quad (1a)$$

$$s.t. \quad S_A^{(t+\delta-1) \bmod T_A + 1} = g, \quad (1b)$$

$$S_B^{(t-1) \bmod T_B + 1} = g, \quad (1c)$$

where $g \in (\mathcal{C}_A \cap \mathcal{C}_B)$ and t means TTR which is the time span from the moment when both users start their channel hopping to the time when they achieve rendezvous for the first time.

IV. QCMS-CH ALGORITHM

A. Basic Idea

The CH sequence generated by the proposed QCMS-CH algorithm can be represented in a matrix structure, and we refer to this matrix as CH matrix. QCMS-CH takes two major steps to build the CH matrix as follows.

Step 1 is to generate a bootstrapping sequence. Each user first randomly selects an available channel and transforms its index (denoted by R) into a fixed-length quaternary number, then uses a specially constructed quaternary-quinary coding table to convert the quaternary number into a quinary number, and then the user adds the prefix “R00” in front of the quinary number to generate a bootstrapping sequence. The length of this bootstrapping sequence determines the number of columns of the CH matrix, and each element of the bootstrapping sequence, which may be one of {R, 0, 1, 2, 3, 4}, corresponds to a column of the CH matrix.

Step 2 is to build the CH matrix column by column. Since there are at most six different types of columns, i.e., R-type and λ -type ($\lambda \in \{0, 1, \dots, 4\}$), six types of subsequences associated with R-type and λ -type can be elaborately generated based on the available channels of the user. Then, we can build the CH matrix by repeatedly placing the corresponding subsequence in each column. Once obtain the CH matrix, the user can access the matrix row by row and accordingly perform its channel hopping to attempt rendezvous with other users. That is, the final CH sequence can be obtained by concatenation each row of the CH matrix.

An illustration on the basic idea of QCMS-CH is given in Fig. 1. Next, we will detail the quaternary-quinary coding table, the generation of bootstrapping sequence as well as the CH matrix.

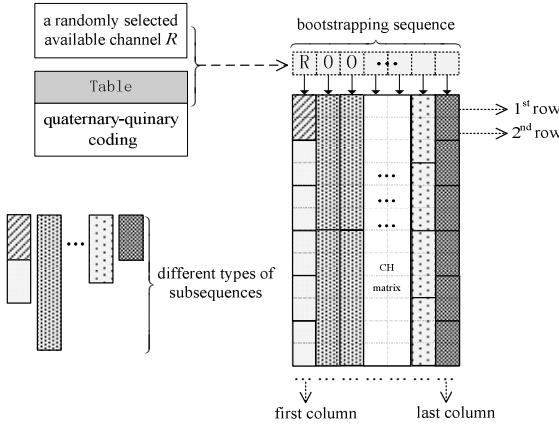


Fig. 1. Illustration of basic idea of QCMS-CH. In the CH matrix, each column repeats the corresponding subsequence. A little exceptional case is the 1st column that is associated with R-type subsequence, where the repeated items is not the whole but a half of the R-type subsequence.

B. Quaternary-Quinary Coding

Table I presents the quaternary-quinary coding, which will be used to generate the bootstrapping sequence. As shown in Table I, each 2-digit quaternary number can be transferred into a 2-digit quinary number. Since there are 16 ($=4^2$) different 2-digit quaternary numbers in total, the size of the quaternary-quinary coding is 16. Our coding is a bijection from 2-digit quaternary numbers to 2-digit quinary numbers, since the selected 2-digit quinary numbers should satisfy the following two conditions and have exact 16 different choices: 1) The first digit is not 0; 2) The first digit and the second digit are different.

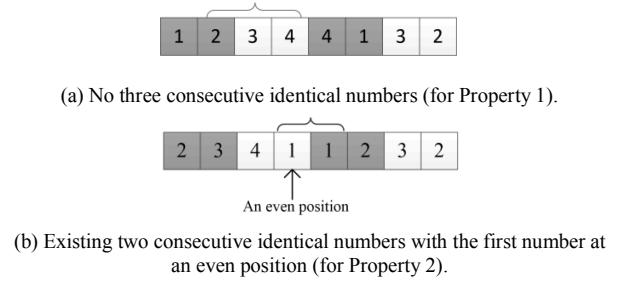
Table I. Quaternary-quinary coding

quaternary	quinary	quaternary	quinary
00	10	20	30
01	12	21	31
02	13	22	32
03	14	23	34
10	20	30	40
11	21	31	41
12	23	32	42
13	24	33	43

The quaternary-quinary coding has two properties, which are given as follows. Due to limited space, we omit the proof of the properties. We give the illustrative examples of these two properties in Fig. 2.

Property 1. Given a sequence which is composed of multiple 2-digit quinary numbers in the quaternary-quinary coding (Table I), there are no three consecutive identical numbers in the sequence.

Property 2. Given a sequence which is composed of multiple 2-digit quinary numbers in the quaternary-quinary coding (Table I), there may be two consecutive identical numbers in this sequence. If so, the first number of the two consecutive identical numbers must be at an even position in the sequence.



(b) Existing two consecutive identical numbers with the first number at an even position (for Property 2).

Fig. 2. Illustrative examples of Property 1 and Property 2.

C. Generation of Bootstrapping Sequence

Based on the aforementioned quaternary-quinary coding, we can describe the generation of bootstrapping sequence as follows (see Algorithm 1 for its pseudocode). Suppose a user randomly selects an available channel (index) R . As shown in Lines 1~3 of Algorithm 1, the decimal number R should first be represented as a quaternary number q . The length of q is an even number which is either $\lceil \log_4 N \rceil$ or $\lceil \log_4 N \rceil + 1$. Next, we may view q as a string and group q into a series of 2-digit quaternary numbers from left to right. Then, each 2-digit quaternary number in q will be transferred into the corresponding 2-digit quinary number, and thereby we can obtain a quinary number (string) Q (see Line 4 of Algorithm 1). Finally, we add a prefix “R00” in front of Q and get the bootstrapping sequence (see Line 5 of Algorithm 1).

Algorithm 1: Generation of bootstrapping sequence

Input: the number of channels N , a randomly selected available channel R , and the quaternary-quinary coding (i.e., Table I).

Output: A bootstrapping sequence BS .

- 1: Represent R as quaternary number q of length $L_q = \lceil \log_4 N \rceil$;
 - 2: **if** (L_q is an odd number)
 - 3: Add a ‘0’ in front of the quaternary number q ;
 - 4: Use Table I to convert q into a quinary number Q by taking two consecutive numbers of q as a group;
 - 5: $BS = "R00" \parallel Q$; // “||”denotes the concatenation operation
 - 6: **return** BS ;
-

An example is given here to illustrate how the bootstrapping sequence is generated. We assume that the number of channels $N=200$ and the set of available channels of user A is $C_A=\{1, 2, 3, 4, 5, 6\}$. If user A randomly selects an available channel $R=5$, R will be represented as quaternary number $q=0011$ with length of $\lceil \log_4 200 \rceil=4$. Base on the quaternary-quinary coding in Table I, q can be transferred into quinary number $Q=1021$ (00 and 11 in q correspond to 10 and 21 in Q , respectively). Then, adding a

prefix “R00” in front of Q will produce the bootstrapping sequence $BS=“R001021”=(R, 0, 0, 1, 0, 2, 1)$.

Given a bootstrapping sequence $BS=(BS(1), BS(2), \dots, BS(L))$ and an integer $d \in [1, L-1]$, we define its rotation as $Rotate(BS, d)=(BS(i_1), BS(i_2), \dots, BS(i_L))$, where $i_j=(j-1+d) \bmod L+1$ ($j=1, 2, \dots, L$) and the mod denotes the modular operation. Then, the bootstrapping sequences generated by Algorithm 1 have the following property. An illustrative example of the property is given in Fig. 3.

Property 3. Given two bootstrapping sequences BS_1 and BS_2 that are generated by Algorithm 1 (BS_1 and BS_2 may be the same), let $S=Rotate(BS_2, d)$ for any $d \in [1, L-1]$, then there exist i and j such that: 1) $BS_1(i)=0$ and $S(j) \in \{1, 2, 3, 4\}$; 2) $S(j)=0$ and $BS_1(j) \in \{1, 2, 3, 4\}$. That is, there exist at least one overlap of number 0 and other number in $\{1, 2, 3, 4\}$ between BS_1 and $Rotate(BS_2, d)$.

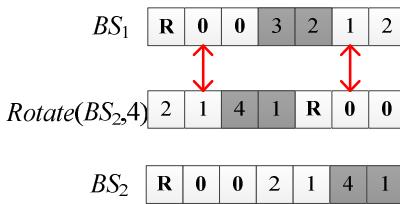


Fig. 3. An illustrative example of Property 3.

D. Generation of Subsequences

There are six different types of subsequences which include R-type and λ -type ($\lambda \in \{0, 1, \dots, 4\}$). Algorithm 2 and Algorithm 3 present the pseudocodes of the generation of R-type subsequence and λ -type subsequence, respectively.

According to Algorithm 2, it is clear that a R-type subsequence has a fix length of 10. Given a randomly selected available channel R , the first five items and the last item in the generated R-type subsequence are equal to R , and the others in the subsequence are denoted by a wildcard character ‘*’. Here, the wildcard character ‘*’ means that it can be replaced by any available channel.

The λ -type subsequence is generated based on the available channels. Specifically, given a set of available channels $\mathcal{C} \subseteq C$, we should first select the smallest prime number $P \geq \max\{n=|\mathcal{C}|, 5\}$ (see Line 1 in Algorithm 3), and then determine the length K of the λ -type subsequence according to both λ and P (see Lines 2-7 in Algorithm 3). The first n items in the the λ -type subsequence are a permutation of \mathcal{C} (see Lines 8 and 10 in Algorithm 3), and the others are denoted by wildcard character ‘*’.

For ease of understanding, we give the examples of R-type and λ -type subsequences in Fig. 4.

Algorithm 2: Generation of R-type subsequence

Input: an available channel R .
Output: A CH sequence $Seq=S(t)|_{t=1, 2, \dots, 10}$.
1: **for** $t=1, 2, \dots, 10$
2: **if** ($t \leq 5$ or $t=10$) $S(t)=R$;
3: **else** $S(t)=“*”$; //wildcard character
4: **return** Seq ;

Algorithm 3: Generation of λ -type subsequence

Input: an available channel set $\mathcal{C}=\{C(1), C(2), \dots, C(n)\} \subseteq C$ and $\lambda \in \{0, 1, 2, 3, 4\}$.
Output: A CH sequence $Seq=S(t)|_{t=1, 2, \dots, K}$.
1: Let P is the smallest prime number $\geq \max\{n, 5\}$;
2: **switch** (λ):
3: **case** 0 : $K=P$;
4: **case** 1 : $K=P+2$;
5: **case** 2 : $K=P+3$;
6: **case** 3 : $K=P+4$;
7: **case** 4 : $K=P+6$;
8: $\mathcal{A}=rearrange(\mathcal{C})$; //a permutation of \mathcal{C}
9: **for** $t=1, 2, \dots, K$
10: **if** $t \leq n$ $S(t)=\mathcal{A}(t)$;
11: **else** $S(t)=“*”$; //wildcard character
12: **return** Seq ;

R-type subsequence	5 5 5 5 5 *	*	*	*	*	5
0-type subsequence	6 4 3 1 2 5 *					
1-type subsequence	2 4 1 6 3 5 *	*	*	*	*	
2-type subsequence	5 3 2 1 4 6 *	*	*	*	*	
3-type subsequence	1 3 2 5 6 4 *	*	*	*	*	
4-type subsequence	3 2 5 6 4 1 *	*	*	*	*	

Fig. 4. Examples of R-type and λ -type subsequences ($\lambda=0, 1, \dots, 4$) for user A with available channel set $C_A=\{1, 2, 3, 4, 5, 6\}$ and a randomly selected available channel $R=5$. In each λ -type subsequence, the items in gray shadow consist of a permutation of C_A .

Regarding the R-type subsequences generated by Algorithm 2 and the λ -type subsequences generated by Algorithm 3, we have the following properties.

Property 4. Given a R-type subsequence Seq , we set $S=Seq(1:5)+Seq(6:10)+Seq(6:10)+\dots+Seq(6:10)+\dots$, where ‘+’ denotes the sequence concatenation operator, then two users can achieve rendezvous within five slots by channel hopping according to sequence S .

An illustrative example of Property 4 is given in Fig. 5.

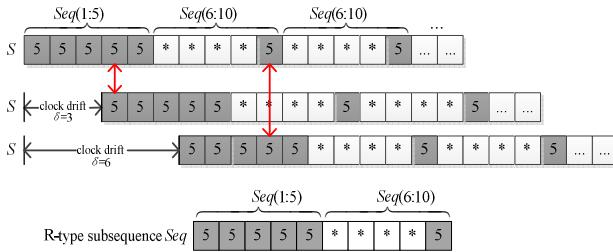


Fig. 5. An illustrative example of Property 4.

Property 5. If P is a prime number not less than 5, then the five numbers $P, P+2, P+3, P+4, P+6$ are mutually coprime.

For example, suppose $P=7$, it can be easily verified that $P=7, P+2=9, P+3=10, P+4=11$, and $P+6=13$ are mutually coprime.

Property 6. Let Seq_A and Seq_B be two λ -type subsequences that users A and B generate based on their available channel sets C_A and C_B , respectively, by using Algorithm 3. If the length of Seq_A is coprime with that of Seq_B , then the two users can visit channel pair $x-y$ for any $x \in C_A$ and $y \in C_B$ within $|Seq_A| \times |Seq_B|$ slots when they implement Seq_A and Seq_B respectively for channel hopping.

An illustrative example of Property 6 is given in Fig. 6. In this example, we assume users A and B have the available channel sets $C_A=\{1, 2, 3, 4, 5, 6\}$ and $C_B=\{1, 7, 8, 9\}$, respectively. Seq_A is a 1-type subsequence of user A , and Seq_B is a 0-type subsequence of user B . We can see that $|Seq_A|=9$ and $|Seq_B|=5$. When the two users repeatedly implement Seq_A and Seq_B respectively, they can visit 24 different channel pairs $x-y$ for $x \in C_A$ and $y \in C_B$ within $|Seq_A| \times |Seq_B|=45$ slots. In particular, we can find that the two users rendezvous on channel 1 after 19 slots (see the line in red color), i.e., with TTR=19.

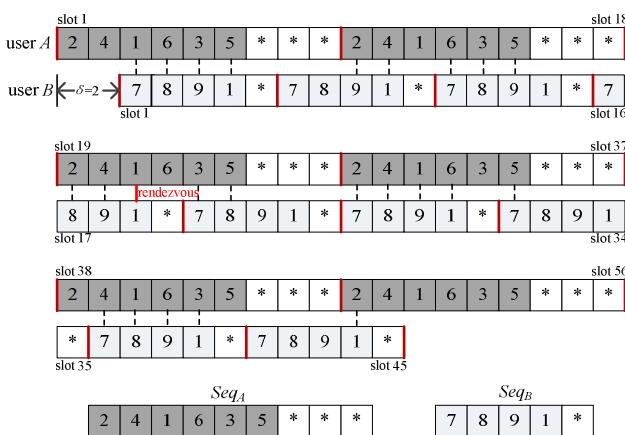


Fig. 6. An illustrative example of Property 6. Assume $C_A=\{1, 2, 3, 4, 5, 6\}$ and $C_B=\{1, 7, 8, 9\}$. Seq_A is a 1-type subsequence of user A , and Seq_B is a 0-type subsequence of user B .

E. QCMS-CH

Based on Algorithms 1~3, i.e., the generation of bootstrapping sequence, R-type and λ -type subsequences, now

we can present the QCMS-CH algorithm, with its pseudocode described in Algorithm 4. When a user implements the QCMS-CH algorithm, the user should first generate its bootstrapping sequence (see Line 2 in Algorithm 4), R-type and λ -type subsequences (see Lines 4-6 in Algorithm 4). Then, the user will perform its channel hopping based on these subsequences to attempt rendezvous (see Lines 8-20 in Algorithm 4).

As pointed out in our basic idea (Section IV.A), a user that implements the QCMS-CH algorithm actually performs its channel hopping by periodically traversing the associated CH matrix (denoted by CHM) in a row-by-row manner. The number of columns of CHM equals L , i.e., the length of the bootstrapping sequence. Except the 1st column (associated with R-type subsequence), the other i th column of CHM is a concatenation of copies of subsequence $Seq^{(i)}$, which can be expressed as $CHM(:, i)=Seq^{(i)}+Seq^{(i)}+\dots+Seq^{(i)}+\dots$ ($i=2, 3, \dots, L$), where ‘+’ denotes the sequence concatenation operator. For the 1st column, which is associated with R-type subsequence, it can be expressed as $CHM(:, 1)=Seq^{(1)}(1:5)+Seq^{(1)}(6:10)+\dots+Seq^{(1)}(6:10)+\dots$, that is, the repeated items is not the whole but a half of the R-type subsequence $Seq^{(1)}$.

Algorithm 4: QCMS-CH

Input: the number of channels N , an available channel set $\mathcal{C}=\{C(1), C(2), \dots, C(n)\} \subseteq \mathbb{C}$, the quaternary-quinary coding (i.e., Table I)

- 1: Randomly select a channel R from \mathcal{C} ;
- 2: $BS=\text{Algorithm 1}(N, R, \text{Table I})$; //bootstrapping sequence
- 3: $L=\text{length of } BS$;
- 4: **for** $i=1, 2, \dots, L$ //generate L subsequences
- 5: **if** $(BS(i)='R')$ $Seq^{(i)}=\text{Algorithm 2}(R)$; //R-type
- 6: **else** $\lambda=BS(i)$; $Seq^{(i)}=\text{Algorithm 3}(\mathcal{C}, \lambda)$; // λ -type
- 7: $t=0$;
- 8: **while** (not rendezvous) //channel hopping
- 9: $i=(t \bmod L)+1$; //in the i th column of CH matrix
- 10: $j=\lceil t/L \rceil+1$; //in the j th row of CH matrix
- 11: **if** $BS(i)='R'$ // implement R-type subsequence
- 12: **if** $j \leq 5$
- 13: $c=Seq^{(i)}(j)$;
- 14: **else**
- 15: $k=(j-6) \bmod 5+6$; $c=Seq^{(i)}(k)$;
- 16: **else** //implement λ -type subsequence
- 17: $k=(j-1) \bmod |Seq^{(i)}|+1$; $c=Seq^{(i)}(k)$;
- 18: **if** $(c='*)$ //wildcard character
- 19: $c=a$ channel randomly selected from \mathcal{C} ;
- 20: Attempt rendezvous on channel c ;

Now, let's give some examples to show how the proposed QCMS-CH algorithm works. Again, we assume users A and

B have available channel sets $\mathbf{C}_A = \{1, 2, 3, 4, 5, 6\}$ and $\mathbf{C}_B = \{1, 7, 8, 9\}$, respectively. Suppose users A and B randomly select available channel $R_A=5$ and $R_B=1$, respectively. Fig. 7(a) shows the bootstrapping sequences and the CH matrices of users A and B , and Fig. 7(b) shows the channel hopping sequences of the two users.

Based on the aforementioned Properties 1-6, we can derive an upper-bound of maximum TTR of the QCMS-CH algorithm, which is presented in Theorem 1 as follows.

Theorem 1. If users A and B implement the QCMS-CH algorithm (i.e. Algorithm 4) based on their available channel sets \mathcal{C}_A and \mathcal{C}_B , respectively, they can achieve rendezvous within $\max\{(P_A+4)(P_B+6), (P_A+6)(P_B+4)\} \times L$ slots, where $L=2\times\lceil\lceil\log_4 N\rceil/2\rceil+3$, P_A and P_B are the smallest prime numbers which are not less than $\max\{5, |\mathcal{C}_A|\}$ and $\max\{5, |\mathcal{C}_B|\}$, respectively.

Based on the setting of Fig. 7, we present several examples in Fig. 8 to further show that QCMS-CH can guarantee rendezvous with short TTR. Notice that users A and B have only one common channel (i.e., channel 1) in this case, which is a difficult situation for the two users to achieve rendezvous. According to Theorem 1, the maximum TTR can be upper bounded by $\max\{(P_A+4)(P_B+6), (P_A+6)(P_B+4)\} \times L$ which is equal to 847 in this case. As shown in Fig. 8, by implementing QCMS-CH users A and B can achieve rendezvous in various scenarios. For example, the two users achieve rendezvous with TTR=15 when clock drift is 2 slots (see Fig. 8(b)) and achieve rendezvous with TTR=22 when clock drift is 5 slots (see Fig. 8(c)). Here, we can find that the actual TTRs are far less than the upper bound of MTTR, which means that the upper bound of MTTR derived in Theorem 1 is a loose bound. We will further demonstrate the

excellent performance of QCMS-CH later through extensive simulations.

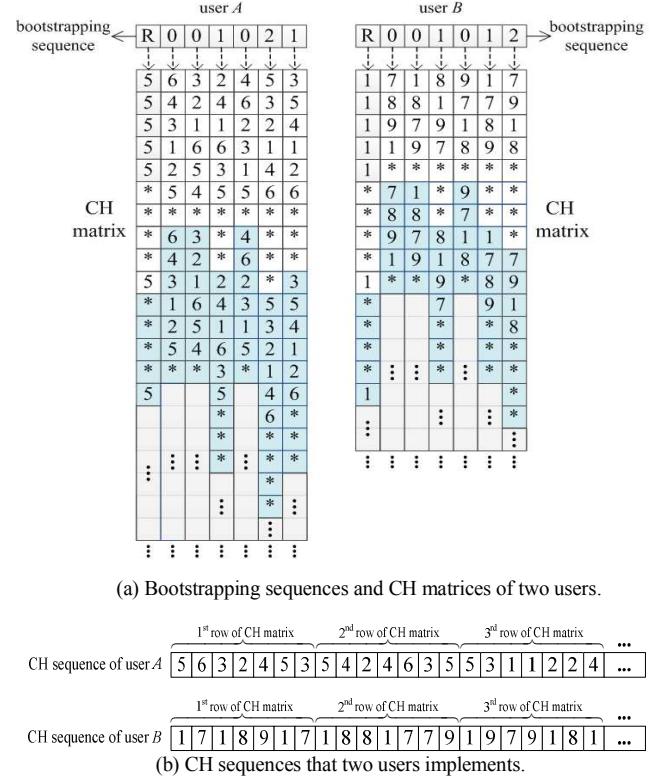


Fig. 7. An illustrative example that users A and B implement the QCMS-CH algorithm (i.e., Algorithm 4). Assume $\mathcal{C}_A = \{1, 2, 3, 4, 5, 6\}$ and $\mathcal{C}_B = \{1, 7, 8, 9\}$; users A and B randomly select available channel $R_A=5$ and $R_B=1$, respectively.

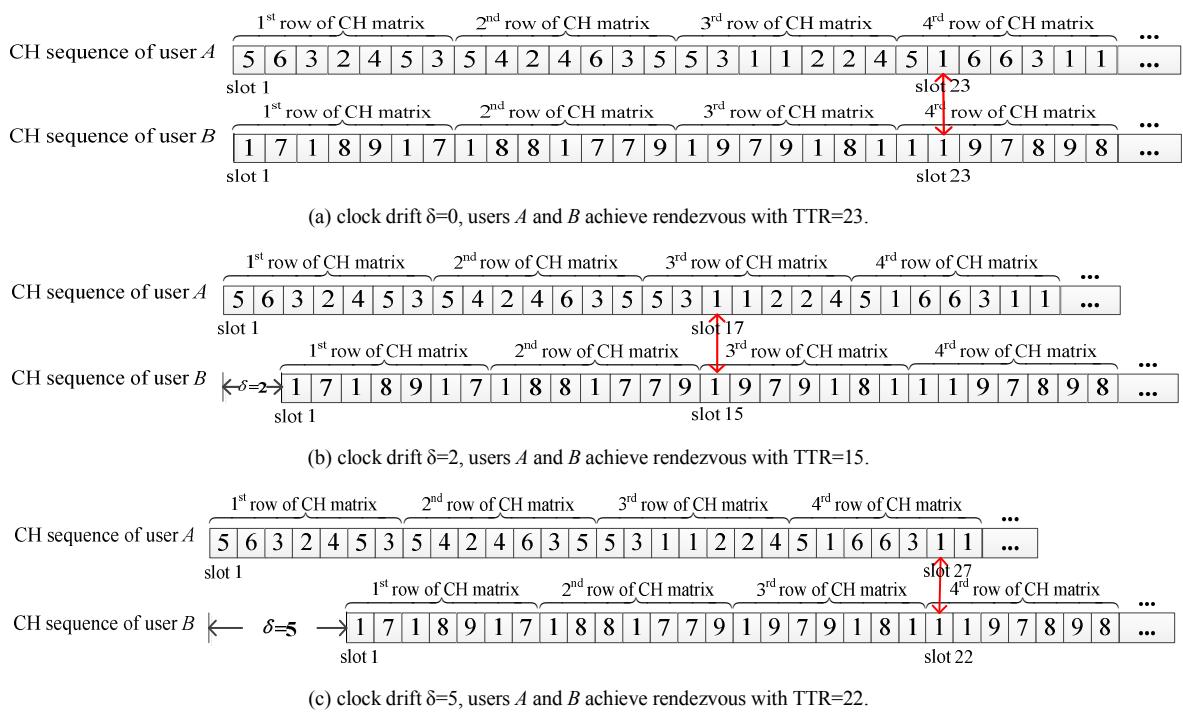


Fig. 8. An illustrative example of guaranteed rendezvous of QCMS-CH.

Table □. Comparisons of different algorithms on MTTR upper-bound.

CH algorithm	Common features	MTTR upper-bound
ABIO [6]		$\text{MTTR} \leq \max\{P_A Q_B, P_B Q_A\} \times (3L + 1).$ $L = \lceil \log_2 N \rceil + 1.$
EEA [5]		$\text{MTTR} \leq M \times P_{A,1} \times P_{B,1}.$ $M = 2 \times \lceil \log_2 \lceil \log_2 N \rceil \rceil + 7.$
QR [7]	✓ symmetric role ✓ heterogeneous channels	$\text{MTTR} \leq M \times P_{A,1} \times P_{B,1}.$ $M = 5 \times \lceil \log_2 N \rceil / 4 + 6.$
IQSF-CH [8]	✓ asynchronous clock ✓ anonymous ID ✓ single-radio ✓ local channel set	$\text{MTTR} \leq F(P_i, P_j) \times (2 \times \lceil \log_2 N \rceil + 3).$ $F(P_i, P_j) = \begin{cases} \max\{(n_j - G)P_j + 2P_i - 1, (n_i P_i - GP_i + 1)P_j\} & \text{if } P_i < P_j \\ (\max\{n_i, n_j\} - G + 1)P_j & \text{if } P_i = P_j \\ \max\{(n_i - G)P_i + 2P_j - 1, (n_j P_j - GP_j + 1)P_i\} & \text{if } P_i > P_j \end{cases}$
QECH [9]		$\text{MTTR} \leq \max\{L_A, L_B\} \times \max\{P_A(P_B + 4), P_B(P_A + 4)\}.$ $L_A = 2^{\lceil \log_2(4+4\lceil \log_2 R_A \rceil / 6) \rceil}.$ $L_B = 2^{\lceil \log_2(4+4\lceil \log_2 R_B \rceil / 6) \rceil}.$
QCMS-CH		$\text{MTTR} \leq \max\{(P_A + 4)(P_B + 6), (P_B + 4)(P_A + 6)\} \times L.$ $L = 2 \times \lceil \lceil \log_4 N \rceil / 2 \rceil + 3.$

Remarks: N is the number of global available channels; G is the number of common available channels of two users; Q_A and Q_B are the smallest integer not less than the number of local available channels of user A and user B , respectively, and the factor of Q_A and Q_B only contain 2 or 3; n_i and n_j are the number of local available channels of user i and user j , respectively; P_i and P_j are the smallest prime number not less than n_i and n_j , respectively; P_A and P_B are the smallest prime number not less than the number of local available channels of user A and user B , respectively, in addition, P_A and P_B must not be less than 5. $P_{A,I}$ and $P_{B,I}$ are the second smallest prime number among the prime numbers that is not less than the number of local available channels of user A and user B , respectively; R_A and R_B are the value corresponding to the channel randomly selected by user A and user B , respectively.

V. PERFORMANCE EVALUATION

In this section, the proposed QCMS-CH algorithm is compared with five state-of-the-art rendezvous algorithms, i.e., EEA [5], ABIO [6], QR [7], IQSF-CH [8], and QECH [9]. Table □ summarizes the related features and MTTR upper bounds of these algorithms.

Recall that N is the number of all potentially available channels, C_A and C_B are the sets of available channels of user A and user B , respectively. We introduce $\theta_A=|C_A|/N$ and $\theta_B=|C_B|/N$ to denote the available channel ratios of users A and user B , respectively. In the simulation, we will vary both θ_A and θ_B to generate different sets of available channels for users A and B .

We use MATLAB 9.8.0 (R2020a) to conduct the simulation. We mainly consider three different scenes with various settings of parameters. Each algorithm is independently executed 30000 times for every setting of parameters, and in each run the clock drift between the two users is randomly selected from $[0, 50]$ so as to simulate the asynchronous clock.

A. Scene 1: Influence of G_{AB} for Fixed θ_A , θ_B and N

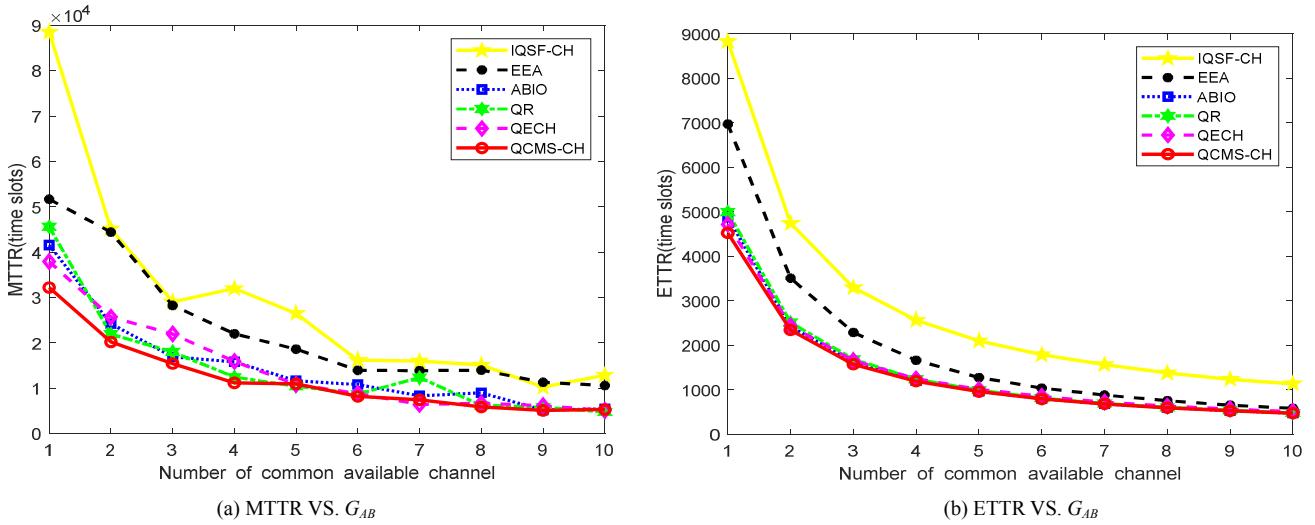
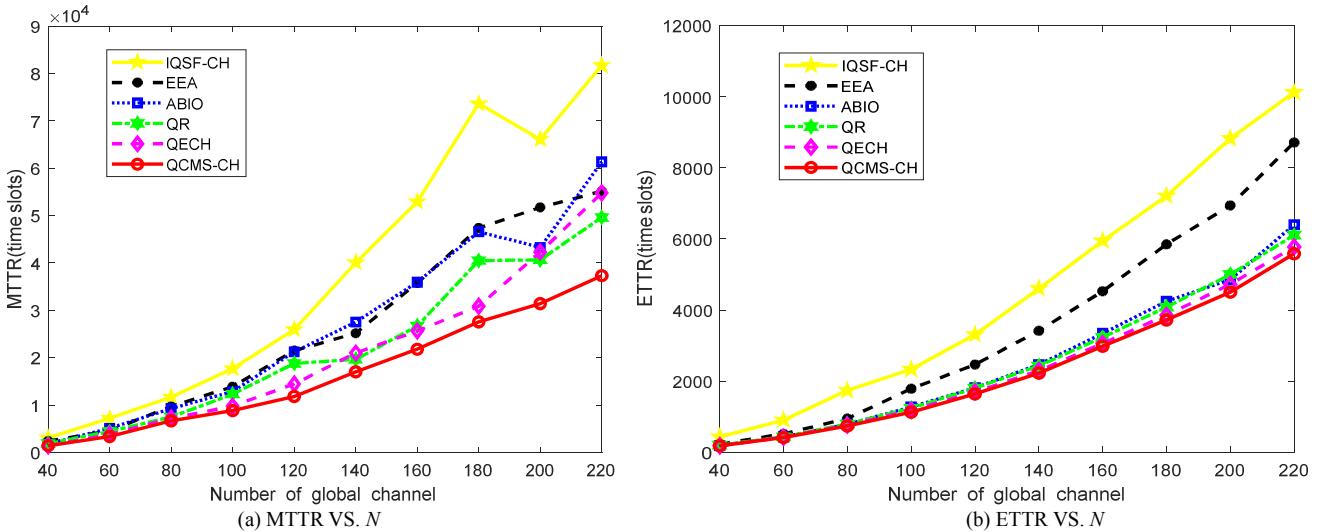
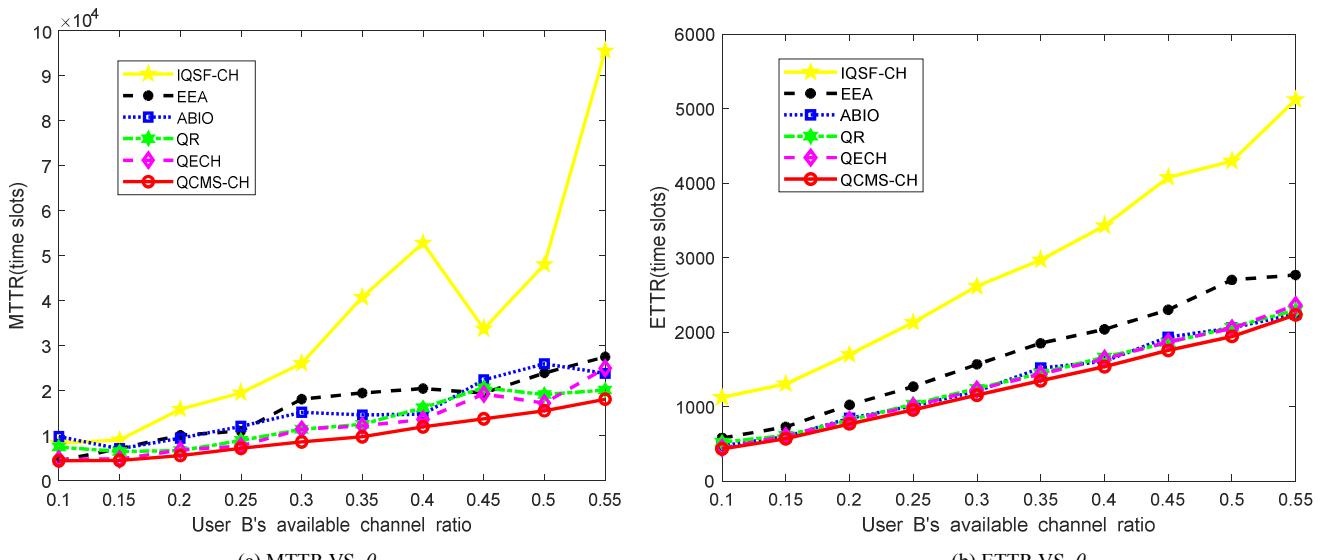
In Scene 1, we fix θ_A , θ_B and N , and observe the influence of varying G_{AB} on MTTR and ETTR. We set the parameters $\theta_A=0.3$, $\theta_B=0.4$, $N=200$ and $G_{AB} \in [1, 10]$. Fig. 9(a) compares the MTTRs of different algorithms. When G_{AB} increases from 1 to 4, the MTTRs of almost all algorithms gradually decrease, and the MTTR of QCMS-CH is the smallest among the six algorithms. In particular, when $G_{AB}=1$, i.e., there is only one channel commonly available to the two users, which is a very tough case for the users to achieve rendezvous, we can find that our QCMS-CH algorithm significantly outperforms the others.

Fig. 9(b) compares the ETTRs of different algorithms. As G_{AB} increases, the ETTRs of all algorithms are gradually decreasing. We can see that the ETTR of QCMS-CH is always the smallest. For example, when $G_{AB}=1$, the ETTR of the second best algorithm QECH (=4722) is 4.31% larger than that of QCMS-CH (=4527). When $G_{AB}=5$, the ETTR of QECH (=1013) is 5.30% larger than that of QCMS-CH (=962). When $G_{AB}=10$, the ETTR of QECH (=513) is 7.55% larger than that of QCMS-CH (=477). It can be seen from the above observations that the ETTRs of other algorithms are on average 5.72% larger than that of QCMS-CH, and the ETTR performance advantage of QCMS-CH is hardly affected by the change of G_{AB} .

B. Scene 2: Influence of N for Fixed θ_A , θ_B and G_{AB}

In Scene 2, we fix θ_A , θ_B and G_{AB} , and observe the influence of varying N on MTTR and ETTR. We set the parameters $\theta_A=0.3$, $\theta_B=0.4$, and $N \in [40, 220]$. Fig. 10(a) compares the MTTRs of different algorithms. We can see the MTTRs of all algorithm increase as N increases and QCMS-CH has the best MTTR. The algorithm QECH is based on local available channel sets rather than global available channel sets to reduce the MTTR. However, in fact, its bootstrapping sequence length needs to be padded to a power of two, so its bootstrapping sequence is longer sometimes, which may result in relatively large MTTR.

Fig. 10(b) compares the ETTRs of different algorithms. As N increases, the ETTRs of all algorithms also increase. In all cases, the ETTR of QCMS-CH is the smallest, which clearly shows the superiority of QCMS-CH. The theoretical MTTR upper-bound of EEA is similar to QCMS-CH in this case (see Table II), but EEA will repeatedly select two channels in multiple time slots [5]. Thus, compared with QCMS-CH, EEA may have a lot of redundancy in its CH sequence, resulting in much larger ETTR.


 Fig. 9. The influence of G_{AB}

 Fig. 10. The influence of N

 Fig. 11. The influence of θ_B

C. Scene 3: Influence of θ_B for Fixed θ_A , N and G_{AB}

In Scene 3, we fix θ_A , N and G_{AB} , and observe the influence of varying θ_B on MTTR and ETTR. We set the parameters $\theta_A=0.1$, $\theta_B \in [0.1, 0.55]$, $N=200$, and $G_{AB}=1$. Fig. 11(a) compares the MTTRs of different algorithms. In most cases, the MTTRs of all algorithms increase with the increase of θ_B . The MTTR of QCMS-CH is still always the smallest, which shows the stability of the performance advantage.

Fig. 11(b) compares the ETTRs of different algorithms. The ETTRs of all algorithms almost increase proportionally with the increase of θ_B . The ETTR of QCMS-CH is always the smallest among the six algorithms. Specifically, when $\theta_B=0.1$, the ETTR of QECH (=444) is 3.50% larger than that of QCMS-CH (=429). When $\theta_B=0.3$, the ETTR of QECH (=1228) is 6.50% larger than that of QCMS-CH (=1153). When $\theta_B=0.5$, the ETTR of QECH (=2049) is 5.46% larger than that of QCMS-CH (=1943). In this scene, the ETTR of QCMS-CH is on average 5.15% better than the compared algorithms.

VI. CONCLUSION

In this paper, we propose a novel quinary coding and matrix structure-based CH algorithm (QCMS-CH) for blind rendezvous in DCRNs. QCMS-CH is applicable to single-radio at each user, asynchronous clocks, heterogeneous available channels, and symmetric roles among the users. Moreover, QCMS-CH depends on only the available channels of user and does not need using user ID. Our theoretical analysis show that QCMS-CH can guarantee rendezvous with relatively small MTTR upper bound. Extensive simulation results have shown the superiority of QCMS-CH in terms of both MTTR and ETTR. In particular, compared with the state-of-the-art, QCMS-CH can achieve 5% reduction in terms of ETTR in many cases.

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Compact Microstrip Ultra-Wideband Bandstop Filter with Quasi-Elliptic Function Response

Hussein N. Shaman, Faris H. Almansour

Abstract— This paper proposes a modified optimum bandstop filter with ultra-wideband stopband. The filter consists of three shunt open-circuited stubs and two non-redundant unit elements. The proposed bandstop filter is designed with unequal electrical lengths of the open-circuited stubs at the mid-stopband. Therefore, the filter can exhibit a quasi-elliptic function response that improves the selectivity and enhances the rejection bandwidth. The filter is designed to exhibit a fractional bandwidth of about 114% at a mid-stopband frequency of 3.0 GHz. The filter is successfully realized in theory, simulated, fabricated and measured. An excellent agreement is obtained between calculated, simulated and measured. The fabricated filter has a compact size with a low insertion loss in the passbands, high selectivity and good attenuation level inside the desired stopband.

Keywords— Microstrip filter; bandstop filter; UWB filter, transmission line filter.

I. INTRODUCTION

Bandstop filters with steep skirt, high attenuation and wideband stopband characteristics are always in demand for blocking undesired signals or to suppress the unwanted spurious harmonics. Recently, various structures of bandstop filters have been proposed to achieve these objectives [1]-[10]. In [1]-[2], a cross-coupling between two nonadjacent transmission lines is introduced, using pair of symmetrical parallel coupled-lines and a capacitive load, to enhance the stopband performance by generating new transmission zeros inside the stopband leading to elliptic/quasi-elliptic response. However, a tight input/output coupling is required to achieve a wide-stopband and the attenuation across the stopband is limited. A further performance enhancement can be achieved by replacing the symmetrical parallel coupled-lines with a stepped-impedance coupled line which generates additional transmission zeros [3]. Bandstop filters with elliptic/quasi-elliptic response can also be built by using hybrid microstrip/coplanar waveguide (CPW)-defected ground structure (DGS) with via-hole connection [4] or using tap coupled open-loop resonators [5] for a limited stopband with FBW of less than 35%. Moreover, stub-enclosed stepped-impedance resonator (SE-SIR) [6] or defected microstrip structure (DMS) [7] can be implemented to obtain dual or triple stopband responses but with limited FBWs. A common filter design for wideband realization is based on a standard conventional filters with quarter-wavelength shunt open-circuited stubs separated by quarter-wavelength connecting lines (unit elements) [8]. The unit elements of conventional filter are redundant and therefore,

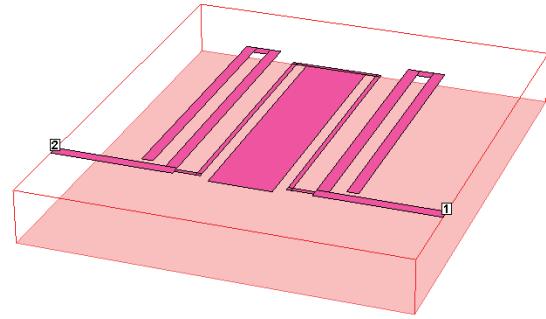


Fig. 1. Configuration of the proposed microstrip bandstop filter with ultra-wide stopband.

their filtering properties are not implemented. In order to enhance the performance of the conventional bandstop filter, the unit elements can be designed as non-redundant element as an optimum filter [9]. Both conventional and optimum bandstop filters using quarter-wavelength open-circuited stubs exhibit only one transmission zero at the mid-stopband. This is because all of their circuit elements have the same electrical length which is a quarter-wavelength at the mid-stopband frequency. Therefore, these types of filters require more elements in order to enhance their performances. Alternatively, a cross coupling is introduced by adding a quarter wavelength parallel-coupled line section that coupled the input and output of the optimum bandstop filter to provide a quasi-elliptic function response [10]. As a result, the filter shows two additional transmission zeros inside the stopband that enhance the selectivity and increase the 30-dB bandwidth of the stopband by more than 32% over the optimum bandstop filter.

In this paper, we propose a new design of a bandstop filter with an ultra-wide stopband. The proposed bandstop filter is designed to have three shunt open-circuited stubs separated by non-redundant unit elements as demonstrated in Fig. 1. The proposed filter is designed to have unequal electrical lengths of the open-circuited stubs. Therefore, the filter can exhibit a ripple stopband which effectively improves the filter selectivity and enhances the rejection bandwidth. The filter is realized on Roger RT5880 microstrip substrate with a relative dielectric constant of (2.2) and with a thickness of (0.254 mm). The theoretical analysis, simulation, and experiment results are demonstrated.

H. Shaman and F. Almansour are with King Abdulaziz City for Science and Technology, Riyadh, 11442 Saudi Arabia (corresponding author; H. Shaman; phone: +966-533742626; e-mail: hshaman@kacst.edu.sa).

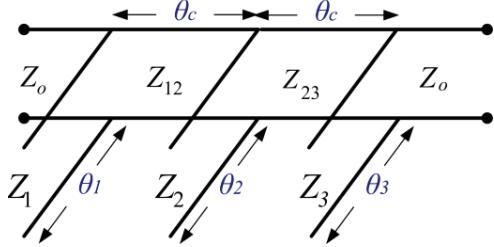


Fig. 2. Circuit model for proposed UWB bandstop filter.

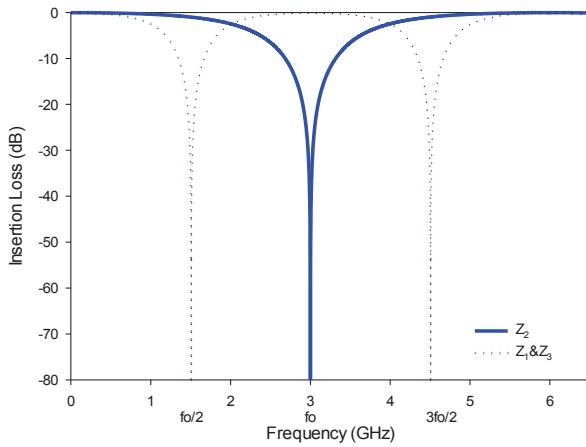


Fig. 3. Calculated insertion loss of Z_2 ($\theta_2 = \lambda/4$ at f_o) and Z_1 & Z_3 ($\theta_1 = \theta_3 = \lambda/4$ at $f_o/2$) shunt connected to a 50 Ohm line .

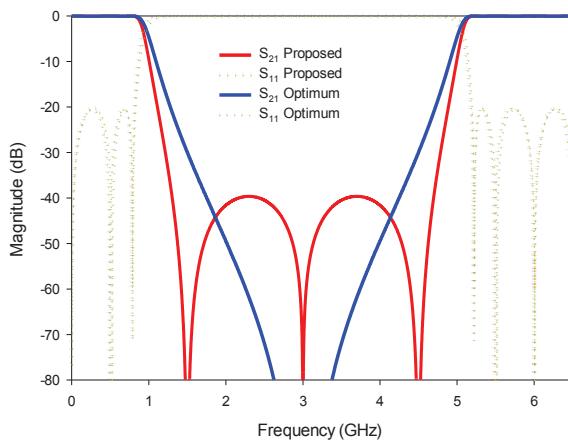


Fig.4. A comparison between the standard optimum filter for $Z_1 = Z_3 = 24.15\Omega$, $Z_2 = 13.16\Omega$, $Z_{12} = Z_{23} = 160\Omega$ and $\theta_1 = \theta_2 = \theta_3 = \theta_c = \lambda/4$ at 3.0GHz with the proposed filter for $Z_1 = Z_3 = 51.7\Omega$, $Z_2 = 12.28\Omega$, $Z_{12} = Z_{23} = 162.9\Omega$, $\theta_1 = \theta_3 = \lambda/4$ at 1.5GHz , and $\theta_2 = \theta_c = \lambda/4$ at 3.0GHz .

II. DESIGN AND ANALYSIS

Fig.1 illustrates the microstrip structure of the proposed filter. The filter design is based on a general circuit model for an optimum bandstop filter with two non-redundant unit

elements and three shunt open-circuited stubs as displayed in Fig. 2 [11]. The open-circuited stubs have characteristic impedances of Z_1 , Z_2 and Z_3 with $Z_1 = Z_3$. The connecting lines have characteristic impedances Z_{12} and Z_{23} , where $Z_{12} = Z_{23}$. The electrical lengths of the shunt open-circuited stubs are represented by θ_1 , θ_2 and θ_3 . The electrical length of the unit element is denoted by θ_c and the terminal impedance is denoted by Z_o . The general transfer function of the optimum bandstop filter with n open-circuited stubs and $n-1$ connecting lines can be written as follows [11]:

$$S_{21}(f)^2 = \frac{1}{1 + \varepsilon^2 F_N^2(f)} \quad (1)$$

where ε is the ripple constant of passband and (F_N) is the filtering function defined as follows:

$$F_N(f) = T_n\left(\frac{t}{t_c}\right)T_{n-1}\left(\frac{t\sqrt{1-t_c^2}}{t_c\sqrt{1-t^2}}\right) - U_n\left(\frac{t}{t_c}\right)U_{n-1}\left(\frac{t\sqrt{1-t_c^2}}{t_c\sqrt{1-t^2}}\right) \quad (2)$$

in which $T_n(x)$ and $U_n(x)$ are the Chebyshev functions and t is the Richard's transform variable given by:

$$t = j \tan\left(\frac{\pi f}{2f_o}\right), t_c = j \tan\left[\frac{\pi}{4}(2 - FBW)\right] \quad (3)$$

where f_o and FBW are the mid-stopband frequency and the fractional bandwidth respectively, and can be defined by:

$$FBW = \frac{f_2 - f_1}{f_o}, f_o = \frac{f_2 + f_1}{2} \quad (4)$$

f_1 and f_2 are the stopband lower and upper cut-off frequencies, respectively. The element values for the optimum bandstop filter, with $\theta_1 = \theta_2 = \theta_3 = \theta_c = \lambda/4$, are available in [11] for very wide range of fractional bandwidths. The standard optimum bandstop filter is designed to exhibit an ultra-wide stopband with a FBW of about 150% at a mid-stopband frequency of 3.0 GHz. The characteristic impedances of the unit elements and the open-circuited stubs of the circuit model, displayed in Fig. 2 with $\theta_1 = \theta_2 = \theta_3 = \theta_c = \lambda/4$ at a mid-stopband frequency of 3.0 GHz, are calculated and found to be as follows: $Z_1 = Z_3 = 24.15\Omega$, $Z_2 = 13.16\Omega$ and $Z_{12} = Z_{23} = 160\Omega$. In order to increase the selectivity of the optimum bandstop filter, transmission zeros inside the stopband can be introduced which increase the bandwidth and also sharpen the filter selectivity. This can be achieved by changing the electrical lengths of the first and last open-circuited stubs to be $\lambda/4$ at $f_o/2$ as shown in Fig. 3. As can be noticed in Fig. 3, the second stub contributes a single transmission zero at the mid-stopband frequency (f_o) while the first and last stubs (Z_1 & Z_3) contribute two transmission zeros at ($f_o/2$) and ($3f_o/2$). A comparison between the computed s-parameters response for the standard optimum bandstop filter and the proposed filter is demonstrated in Fig. 4. As can be noticed in Fig. 4, both filters have identical

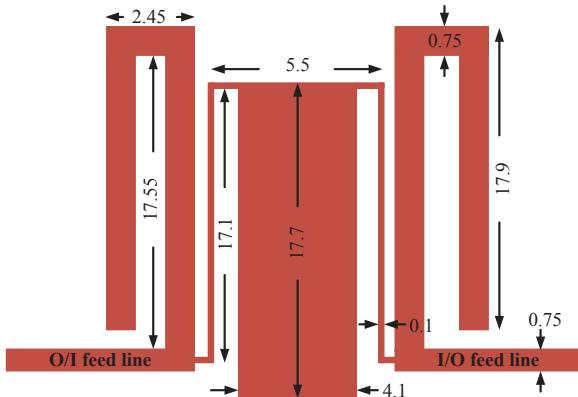


Fig. 5. Microstrip layout of the ultra-wideband bandstop filter. (Unit: mm).

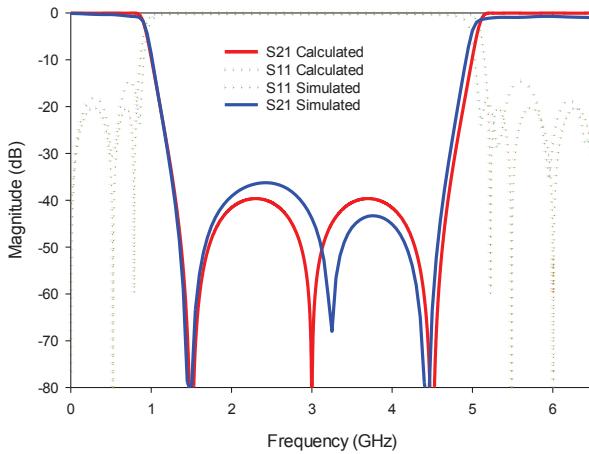


Fig. 6. A comparison between the calculated and full-wave EM simulated magnitude responses.

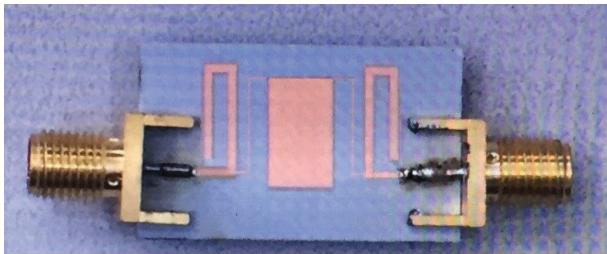


Fig. 7. A photograph of the prototype filter.

performance inside the two passbands but different performance inside the stopband. Since all the open-circuited stubs are a quarter-wavelength at $f_o = 3.0$ GHz, the standard optimum bandstop filter only shows a single transmission zero at 3.0GHz (f_o). However, the proposed filter exhibits additional transmission zeros inside the desired stopband at 1.5

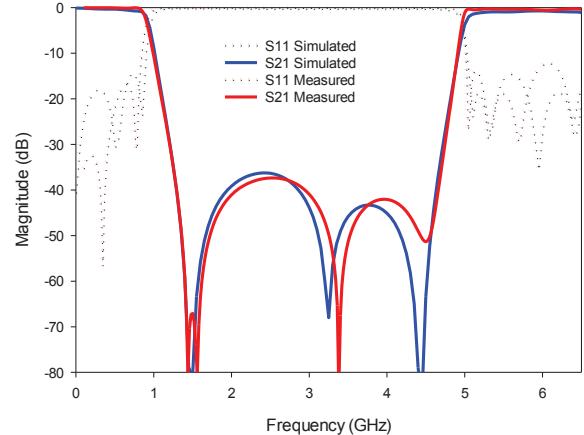


Fig. 8. A comparison between the full-wave EM simulated and measured magnitude responses.

GHz ($f_o/2$) and at 4.5 GHz ($3f_o/2$). Since the open-circuited stubs of the proposed filter resonates at three different frequencies ($f_o/2, f_o, 3f_o/2$), the proposed filter shows elliptic function response with ripples in both stopband and passband. Thus, the selectivity of the proposed filter is effectively enhanced and the 40-dB rejection bandwidth is extended by more than 36% compared to the optimum filter with the same number of stubs.

III. IMPLEMENTATION AND EXPERIMENT

The design of the proposed bandstop filter is realized on a Roger RT5880 substrate with a thickness of 0.254 mm and a relative dielectric constant of 2.2. The microstrip layout with the physical lengths of the filter design is depicted Fig. 5. The first and third open-circuited stubs and the unit elements are folded to shrink the size of the layout. The microstrip layout of the filter design is simulated using commercially available tool [12]. Fig. 6 displays the calculated and the full-wave EM simulated insertion and return losses of the proposed filter, where excellent agreement is attained. Using print-circuit-board (PCB) technology, the microstrip filter layout is fabricated. The fabricated filter which is photographed in Fig. 7, including 5.0 mm feed line at the input and the output, occupies a small size of 19.4 mm by 18.9 mm. The fabricated prototype is measured where the measurement performance is compared to the simulated result as shown in Fig. 8. Excellent agreement is obtain where both simulated and measured results show three transmission zeros at the wanted stopband. The filter prototype shows an ultra-wide stopband with a 40-dB fractional bandwidth of approximately 114% at a mid-band frequency of 3.0 GHz with a very high selectivity. The measured insertion loss is found to be 0.5 dB at the mid-band frequency of the first passband and less than 1.3 dB at the mid-band frequencies of the upper passband.

IV. CONCLUSION

A bandstop filter with an ultra-wide stopband has been proposed and presented in this paper. The proposed bandstop filter comprises of two non-redundant unit elements and three shunt open-circuited stubs. The proposed bandstop filter has been successfully realized in theory, simulated, fabricated and measured. It has been shown that the proposed filter can exhibit a ripple stopband which effectively improves the filter selectivity and enhances the rejection bandwidth. It has been verified that the proposed technique not only enhances the filter selectivity, but it also widens the 40-dB bandwidth by more than 36% over that of the optimum design. The fabricated filter has the advantages of low insertion loss, small size and ultra-wide rejection band.

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Investigation of Gravity Anchor Under Scour, and Anchor Transportation and Installation (T&I)

Vinay Kumar Vanjakula, Frank Adam

Abstract— The generation of electricity through wind power is one of the leading renewable energy generation methods. Due to much higher wind speeds far away from shore, the construction of offshore wind turbines began in the last decades. However, the installation of offshore foundation-based (monopiles) wind turbines in deep waters are often associated with technical and financial challenges. To overcome such challenges, the concept of floating wind turbines is expanded as the basis of the oil and gas industry. For such a floating system, stabilization in harsh conditions is a challenging task. For that, a robust heavy-weight gravity anchor is needed. Transportation of such anchor requires a heavy vessel that increases the cost. To lower the cost, the gravity anchor is designed with ballast chambers that allow the anchor to float while towing and filled with water when lowering to the planned seabed location. The presence of such a large structure may influence the flow field around it. The changes in the flow field include, formation of vortices, turbulence generation, waves or currents flow breaking, and pressure differentials around the seabed sediment. These changes influence the installation process. Also, after installation and under operating conditions, the flow around the anchor may allow the local seabed sediment to be carried off and results in Scour (erosion). These are a threat to the structure stability. In recent decades, rapid developments of research work and the knowledge of scouring on fixed structures (bridges and monopiles) in rivers and oceans have been carried out, and very limited research work on scouring around a bluff-shaped gravity anchor.

The objective of this study involves the application of different numerical models to simulate the anchor towing under waves and calm water conditions. Anchor lowering involves the investigation of anchor movements at certain water depths under wave/current. The motions of anchor drift, heave, and pitch is of special focus. The further study involves anchor scour, where the anchor is installed in the seabed; the flow of underwater current around the anchor induces vortices mainly at the front and corners that develop soil erosion. The study of scouring on a submerged gravity anchor is an interesting research question since the flow not only passes around the anchor but also over the structure that forms different flow vortices. The achieved results and the numerical model will be a basis for the development of other designs and concepts for marine structures. The Computational Fluid Dynamics (CFD) numerical model will build in OpenFOAM and other similar software.

Keywords— anchor lowering, anchor towing, scour, gravity anchor, computational fluid dynamics.

Vinay Kumar Vanjakula is with the in Technical University of Braunschweig, Germany (e-mail: v.vanjakula@gicon.de).

3-Dimensional Contamination Conceptual Site Model: A Case Study Illustrating the Multiple Applications of Developing and Maintaining a 3D Contamination Model During an Active Remediation Project on a Former Urban Gasworks Site

Duncan Fraser

Abstract— A 3-Dimensional (3D) conceptual site model was developed using the Leapfrog Works® platform utilising a comprehensive historical dataset for a large former Gasworks site in Fitzroy, Melbourne. The gasworks had been constructed across two fractured geological units with varying hydraulic conductivities. A Newer Volcanic (basaltic) outcrop covered approximately half of the site and was overlying a fractured Melbourne formation (Siltstone) bedrock outcropping over the remaining portion. During the investigative phase of works a dense non-aqueous phase liquid (DNAPL) plume (coal tar) was identified within both geological units in the subsurface originating from multiple sources including gasholders, tar wells, condensers and leaking pipework.

The first stage of model development was undertaken to determine the horizontal and vertical extents of the coal tar in the subsurface and assess the potential causality between potential sources, plume location and site geology. Concentrations of key contaminants of interest (COI's) were also interpolated within Leapfrog to refine the distribution of contaminated soils. The model was subsequently used to develop a robust soil remediation strategy and achieve endorsement from an Environmental Auditor.

A change in project scope, following the removal and validation of the three former gasholders, necessitated the additional excavation of a significant volume of residual contaminated rock to allow for the future construction of two-storey underground basements.

To assess financial liabilities associated with the offsite disposal or thermal treatment of material, the 3D model was updated with three years of additional analytical data from the active remediation phase of works. Chemical concentrations and the residual tar plume within the rock fractures were modelled to pre-classify the in-situ material and enhance separation strategies to prevent the unnecessary treatment of material and reduce costs.

Keywords— 3D Model, Contaminated Land, Leapfrog, Remediation .

Duncan Fraser is with the in Flinders University, Australia (e-mail: duncan.fraser@wsp.com).

Human Wildlife Conflict Outside Protected Areas of Nepal: Causes, Consequences and Mitigation Strategies

Kedar Baral

Division Forest Office, Kaski, Nepal

Abstract— This study was carried out in Mustang, Kaski, Tanahun, Baitadi and Jhapa districts of Nepal. The study explored spatial and temporal pattern of HWC, socio economic factors associated with it, impacts of conflict on life / livelihood of people and survival of wildlife species and impact of climate change and forest fire on HWC. Study also evaluated people's attitude towards wildlife conservation and assessed relevant policies and programs. Questionnaire survey was carried out with the 250 respondents and both socio-demographic and HWC related information were collected. Secondary information were collected from Divisional Forest Offices and Annapurna Conservation Area Project. HWC events were grouped by season /months/sites (forest type, distances from forest and settlement) and the coordinates of the events were exported to ArcGIS. Collected data were analyzed using descriptive statistics in Excel and R Program.

A total of 1465 events were recorded in 5 districts during 2015 and 2019. Out of that, livestock killing, crop damage, human attack and cattle shed damage events were 70 %, 12% 11% and 7% respectively. Among 151 human attack cases, 23 people were killed and 128 were injured. Elephant in Terai, common leopard and monkey in Middle Mountain and snow leopard in high mountains were found as major problematic animals. Common leopard attacks were found more in autumn, evening and on human settlement area. Whereas elephant attacks were found higher in winter, day time and on farmland. Poor people farmers were found highly victimized and they were losing 26% of their income due to crop raiding and livestock depredation. On the other hand, people are killing many wildlife in revenge and this number is increasing every year. Based on the people's perception, climate change is causing increased temperature and forest fire events and decreased water sources within forest. Due to the scarcity of food and water within forests wildlife are compelled to dwell at human settlement area, hence HWC events are increasing. Nevertheless, more than half of the respondents were found positive conserving entire wildlife species. Forests outside PAs are under community forestry (CF) system which restored the forest, improved the habitat and increased the wildlife. However, CF policies and programs were found more focused on forest management with least priority on wildlife conservation and HWC mitigation. Compensation / relief scheme of government for wildlife damage was found some how effective to manage HWC but the lengthy process, being applicable to the damage of few wildlife species and highly increasing events made it necessary to revisit.

Based on these facts, study suggest to carry out awareness generation activities to the poor farmers, linking the property of people with the insurance scheme, conducting habitat management activities within CF, promoting the unpalatable crops, improvement of shed house of livestock, simplifying compensation scheme and establishing fund at district level and incorporating the wildlife conservation and HWC mitigation programs in CF. Finally, study suggests to carry out rigorous researches to understand the impacts of current forest management practices on forest, biodiversity, wildlife and HWC.

Keywords : *Community Forest, conflict mitigation, wildlife conservation, climate change*

Parasitic Infection among Farmers Dealing with Treated Wastewater in Al-Zaitoun Area, Gaza City

Haneen Nabil Al-Sbaihi^{1*}, Adnan Al-Hindi², Khalid Qahman³

1 Environmental Engineering B.Sc. – Islamic University of Gaza, Public Health – Epidemiology M.Sc.– Al-Quds University (Abu Dees) - Gaza, Palestine.

2 Professor of Parasitology-Islamic University of Gaza - Gaza, Palestine.

3 Assistant Professor in Civil and Environmental Engineering – Environment Quality Authority - Gaza, Palestine.

*Email: hsbaihi@hotmail.com

Abstract

Treated wastewater irrigation is associated with several benefits but can also lead to significant health risks. The main objective of this study is to investigate the parasitic infection (PI) among farmers dealing with treated wastewater (TWW) in Al-Zaitoun area- Gaza City. This study included two farmer groups: farmers who dealing with TWW (Mixed water users (MWUs)), and farmers who irrigate by using groundwater (GW) (Ground water users (GWUs)). Each participant was asked to provide stool samples on two phases. The two farmer groups were use GW in the 1st phase while the MWUs were use TWW in the 2nd phase which was after using TWW in irrigation for three months. Prevalence of PI was 30.9% and increased to be 47.3% in the 2nd phase. Negative association not statistically significant ($OR=0.659$, $CI\ 0.202-2.153$) was found in the 1st phase, while a positive association not statically significant was found between PI and TWW in the 2nd phase ($OR=1.37$, $CI\ 0.448-4.21$). In this study six parasites species were identified among participants: *Entamoeba histolytica/dispar* and *coil*", *Cryptosporidium*, *Microsporidia*, *Giardia lamblia*, *Strongyloides stercoralis*, and *Ascaris lumbricoides*.

Keywords: Wastewater, Groundwater, Treated wastewater, Parasitic infection, parasites.

1. Introduction

Wastewater (WW) increasingly used for agriculture in both developing and industrialized countries as a result of (a) Increasing water scarcity, stress and degradation of fresh water resources resulting from improper disposal of wastewater. (b) Population increase and related increasing demand for food. (c) A growing recognition of the resource value of wastewater and the nutrients it contains. (d) Ensuring environmental sustainability and elimination poverty and hunger [1]. WW contains a variety of different pathogens, many of which are capable of survival in the environment (in the wastewater, on the crops, or in the soil) long enough

to be transmitted to human. In places where WW is used without adequate treatment, the greatest health risks are usually associated with intestinal helminths [1]. The health hazards associated with WW use in irrigation are of three kinds: (a) The rural health and safety problem for those working on the land where the WW is being used (farmers workers and their families), (b) Population groups consuming crops irrigated by TWW, and (c) Health effects among population residing near wastewater-irrigated fields [2]. Health risk associated with wastewater reuse (WWR) may differ in different subgroups of the population. The most important subgroup to consider are agricultural workers exposed occupationally (occupational risk) and persons consuming crops irrigated with the wastewater (consumer risk) [3]. Many studies reported the parasitic risk from WWR between farmers. In Pakistan it was reported that farmers who use WW in irrigation were five times more likely to be infected with hookworms than others using canal water [4]. In Senegal where, only WW is available 60% of farmers were infected with intestinal helminths [5]. Uganda farmers who exposed to WW were more likely to be infected with helminths than slum dwellers and workers involved in sludge collection [6].

The parasitic infection between farmers who use TWW in agriculture is a known public health issue in the world, but not studied yet in Gaza strip (GS). This study is a Pioneer study will investigate the parasitic infection among farmers dealing with TWW in Al-Zaitoun area-Gaza City in order to submit suitable recommendations that could be helpful for decision makers to take the necessary measures in order to reduce the possible infection and protect the health of farmers and their families who involved or will be involved in WWR projects.

2. Materials and Method

This study is a comparative study aimed to investigate the parasitic infection among farmers dealing with treated wastewater in Zaitoun area, Gaza City by comparison two farmer groups: farmers who dealing with TWW in agriculture at El-Zaitoun area (exposed

group), and farmers who irrigate by using GW (agricultural/private/municipal wells) at Joher Al-Deek area (non-exposed group).

Each farmer was asked to provide three consequently stool samples on separate days to be submitted with no more than 10 days at the two study phases; the 1st phase was in May, 2016 and the 2nd phase was in December, 2016. Three stool samples are considered a minimum for an adequate parasitic detection since many organisms particularly the intestinal protozoa do not appear in stool in consistent numbers on a daily basis [7]. Stool samples in the 1st phase aimed to ensure farmers especially the exposed group are non-parasitic infected before using TWW in irrigation; otherwise, farmer will be excluded from the sample or treated before beginning the 2nd phase. The 2nd phase was to compare the difference in parasitic infection prevalence between exposed farmers who irrigate their lands with TWW for three months and non-exposed farmers who still using GW. In order to choose study participants two awareness/orientation sessions were conducted in the beginning of May, 2016 for exposed and non-exposed farmers' group respectively to increase farmers awareness, knowledge about parasitic infection that result from working in agriculture and in the same time to obtain their consent for participation in the study. Most of farmers had agreed to participate, cooperate and commit in the study requirements. Educational materials about collecting representative stool sample, three stool cups with 4ml of 10% formalin as a preservative, and three paper bags were distributed to each participant to provide preserved stool samples. All collected stool samples were sent to Islamic University Lab for parasitic analysis. The microscopic examination of the stool samples consists from three separate techniques: **1. Direct wet smear;** as a rapid screening technique [8], it was applied according to [7]. **2. Concentration (sedimentation);** as the concentration technique allows detection the small numbers of organisms that may be missed by using the direct wet smear [7]. As the stool samples were preserved in 10% formalin, the procedure was applied according to [7] for preservative samples. **3. Permanent stained smear (Acid-fast staining),** as the Acid-fast staining allows detection and identification the small protozoan organisms that missed with the direct smear and concentration methods as Cryptosporidium and Microsporidia. It was applied according to [9].

3. Results and Discussion

3.1 Study Participants

The number of participants in this study was 55 farmer. Participants were distributed according to the source of the used irrigation water into two groups of farmers: MWUs and GWUs, as shown in figure (1). The number of MWUs, farmers who are using the TWW and GW, was 36; while the number of GWUs, farmers who are using the GW only, was 19.

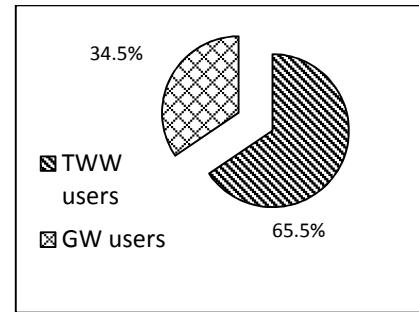


Figure 1: Study participants distribution

3.2. Collected Samples Analysis Results

3.2.1. Stool samples analysis results in the 1stphase:

Regarding stool samples analysis results in the 1st phase, it was found (17) participants had parasitic infection; about (10) (58.8%) of the infected participants were from the MWUs group, while (7) (41.1%) were from the GWUs group.

Five parasites species were identified in stool samples: *Cryptosporidium*, *E. histolytica/dispar*, *Microsporidia*, *G. lamblia*, and *S. setercoralis*.

3.2.2. Stool samples analysis results in the 2nd phase:

Regarding stools samples analysis results in the 2nd phase, it was found (26) participants had parasitic infection; about (18) (69.2%) of the infected participants were from the MWUs group, while (8) (30.7%) were from the GWUs group.

Five parasites species were identified in stool samples: *E. histolytica/dispar and Coli*, *Cryptosporidium*, *Microsporidia*, *G. lamblia*, and *A. lumbricoides*.

3.3. Parasitic infection prevalence

3.3.1. Parasitic infection prevalence in the 1st phase:

At the 1st phase, the overall prevalence of parasitic infection of participants was (30.9%), The parasitic infection prevalence of MWUs and GWUs were (27.8%), (36.8%) respectively as shown in figure (2). In this phase *negative association, not statistically significant was found between PI and TWWR.* ($OR=0.659$, $CI (0.202-2.153)$).

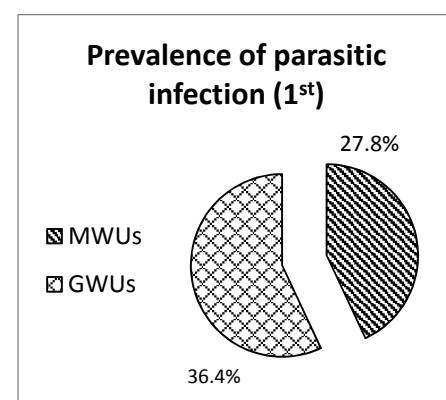


Figure 2: Parasitic infection in the 1st phase

The prevalence of the five parasites species that found in stool samples in the 1st phase were as follows *Cryptosporidium* was the predominant recognized genus with a prevalence of (14.5%) followed by *E. histolytica/dispar*, *Microsporidium*, *G. lamblia cyst*, and *S. stercoralis larvae* with a prevalence of (12.7%), (10.9%), (3.63%), (1.81%) respectively as shown in figure (3).

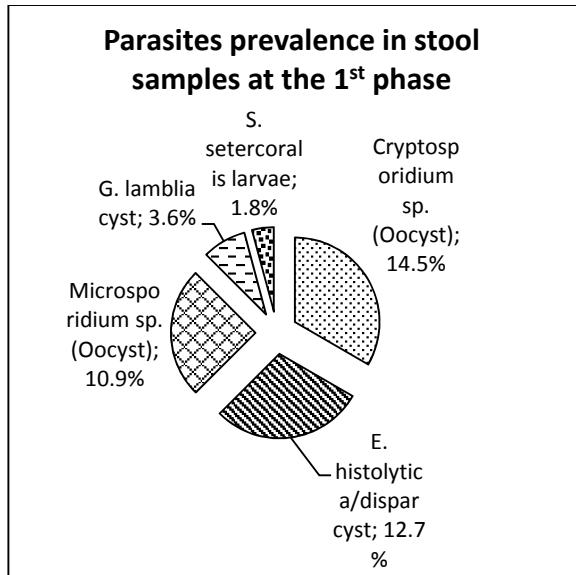


Figure 3: Parasites prevalence in stool samples at the 1st phase

3.3.2. Parasitic infection prevalence in the 2nd phase:

At the 2nd phase, the overall parasitic infection prevalence of participants increased to became (47.3 %). The PI prevalence of MWUs and GWUs were (50%), (42.1%) respectively as shown in figure (4). In this phase a positive association, not statistically significant was found between PI and TWWR ($OR=1.37$, $CI (0.448-4.21)$.

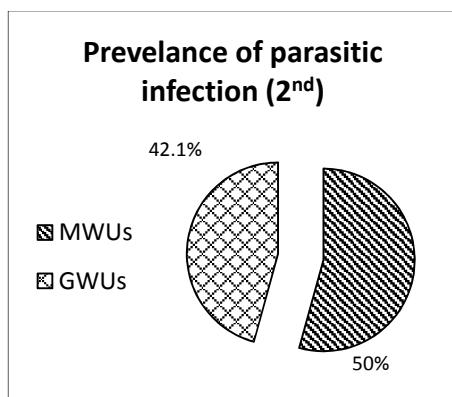


Figure 4: Parasitic infection in the 2nd phase

The prevalence of the five parasites species that found in stool samples in the 2nd phase were as follows *E. histolytica/dispar/coli* was the predominant identified genus with a prevalence of (25.4%) followed by *Cryptosporidium*, *Microsporidium*, *G. lamblia cyst*, and *S. stercoralis* with a prevalence of (18.1%), (9.1%), (5.45) (1.81) respectively as shown in figure (5).

and *A. lumbricoides* with a prevalence of (18.1%), (9.1%), (5.45) (1.81) respectively as shown in figure (5).

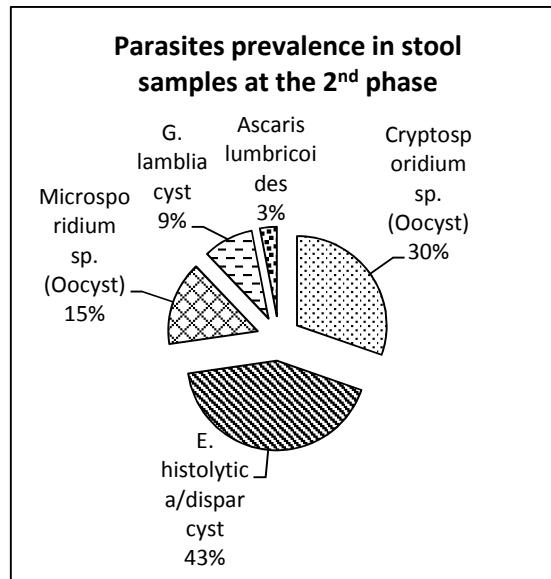


Figure 5: Parasites prevalence in stool samples at the 2nd phase

3.4. Prevalence of some parasitic species

The OR value for *E. histolytica/dispar/coli* and *G. lamblia* prevalence increased to be more than one in the 2nd phase meaning that there is a positive association between prevalence of *E. histolytica/dispar/coli* and *G. lamblia* and using TWW in irrigation which confirm the infection by *E. histolytica/dispar/coli* and *G. lamblia* are the most wastewater related waterborne diseases, as it was found Crittenden et al. 2005 as cited in [10]. revealed the protozoans associated with waterborne disease mainly include *E. histolytica*, *Edispar*, *G. lamblia*, and *Cryptosporidium parvum*.

3.5. Treatment the infected participants

After the 1st phase and the 2nd phase each participant had infection, he/she treated by proper chemotherapy with coordination with in Rimal Healthcare Center and under supervision a physician at Al-Zaitoun Healthcare center, the below table shows the medication types that used for treating the infected participants.

Table 1: Medication types that used for treated infected participants

Parasite	Medication	Frequency
<i>E. histolytica</i> / <i>dispar</i> cyst	Cystogen	2*3*10 (adults) 5cc *3*10 (children)
<i>G. lamblia</i> cyst	Cystogen	2*3*10 (adults) 5cc *3*10 (children)
<i>Cryptosporidium</i> sp. (Oocyst)	Azicare	5 tablets (500mg) per day (adults) 5cc per day(children)
<i>Microsporidium</i> sp. (Oocyst)	Albendazole	1*2*14 (adults and children)
<i>A. lumbricoides</i>	Vermox	5cc *2*3 (children)
<i>S. stercoralis</i>	Albendazole	0.5*2*14 (children)

4. Conclusion

It was found a positive association not statically significant between TWWR and PI and between prevalence of *E. histolytica/dispar* and *G. lamblia* and using TWW in irrigation. *Cryptosporidium* was the predominant recognized genus followed by *E. histolytica/dispar*, *Microsporidium*, and *G. lamblia* in the 1st phase. While *E. histolytica/dispar* was the predominant recognized genus followed by *Cryptosporidium*, *Microsporidium*, and *G. lamblia* in the 2nd phase.

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Modified Otsuka Method for Local TEC Mapping

F. I. Constantin^{1,2}, E. M. Popescu¹, G. Chirițoi¹, E. I. Năstase³, A. Muntean³

¹ Institute of Space Science, Măgurele, Romania

² Faculty of Physics, University of Bucharest

³ National Institute for Earth Physics, Măgurele, Romania

Abstract— One method to create TEC maps based on observable data from satellites picked up by ground receivers that have a high spatial resolution is the one detailed by Otsuka et al. This study generalizes the method to function under the harshest initial conditions while maintaining a spatial resolution in the obtained TEC maps of approximately 55 km^2 . The new method has been tested over the territory of Romania.

Keywords— TEC, TEC map, ionosphere, space weather.

The Nature of Mineralizing Fluids in the Hammam Zriba Deposit (F-Ba-Sr-Pb-Zn) in North-eastern Tunisia

Miladi Yasmine, Bouhlel Salah, David Banks

¹ *Laboratory of Mineral Ressources and Environment, Department of Geology, Faculty of Mathematical, Physical and Natural Sciences, University of Tunis El Manar, Campus, 2092 Tunis, Tunisia*

² *School of Earth sciences, Université of Leeds, Leeds LS2 9JT, United Kingdom*

miladi.yasmine84@gmail.com

Abstract

The Hammam Zriba (F-Ba-Sr-Pb-Zn) ore deposits of the Zaghouan district are located in northeast Tunisia, 60 Km south of Tunis. The host rocks belong to the Ressas Formation (Tithonian age) and lower Cretaceous layers. Mineralization occurs as stratiform replacement heaps and lenses. The mineral assemblage is composed of fluorite, barite, sphalerite, and galena. Primary fluid inclusions in sphalerite have homogenization temperatures ranging from 83 to 140°C, final melting temperature range from -18 to -7.0, corresponding to salinities of 5 to 21 wt % NaCl equivalent. Fluid inclusions in fluorite homogenize to the liquid phase between 132 and 178°C. Final ice melting temperatures range from -25 to -6.8 °C, corresponding to salinities between 17 and 24 wt% NaCl equiv. The LA-ICP-MS analyses of the fluid inclusions in fluorite show that these fluids are dominated by Na>Ca>K>Mg, with the concentration of Fe being equivalent to that of Mg. Microthermometric analyses of the fluid inclusions observed in fluorite and sphalerite show that two distinct fluids were involved in the mineralization deposition: a warmer saline fluid (132-178°C, 17-24 wt % NaCl equivalent) and cooler saline fluid (83°C-140, 5-21 wt %NaCl equivalent). The ore fluid result from highly saline and Na-Ca dominated with lower Mg concentrations come from the leaching of the dolomitic host rocks by the fluids.

Keywords: Hammam Zriba , Fluid inclusions, LA-ICP-MS, Zaghouan district.

Identification of the Usage of Some Special Places in the Prehistoric Site of Tapeh Zagheh through Multi-Elemental Chemical Analysis of the Soil Samples

Iraj Rezaei¹, Kamal Al Din Niknami²

Abstract— Tapeh Zagheh is an important prehistoric site located in the central plateau of Iran which has settlement layers of the Neolithic and Chalcolithic periods. For this research, 38 soil samples were collected from different parts of the site, as well as two samples from its outside as witnesses. Then the samples were analyzed by XRF. The purpose of this research was to identify some places with special usage for human activities in Tapeh Zagheh by measuring the amount of some special elements in the soil. The result of XRF analysis shows a significant amount of P and K in samples No.3 (fourth floor) and No.4 (third floor), probably due to certain activities such as food preparation and consumption. Samples No.9 and No.10 can be considered suitable examples of the hearths of the prehistoric period in the central plateau of Iran. The color of these samples was completely darkened due to the presence of ash, charcoal, and burnt materials. According to the XRF results, the soil of these hearths has very high amounts of elements such as P, Ca, Mn, S, K, and significant amounts of Ti, Fe, and Na. In addition, the elemental composition of sample No. 14, which was taken from a home waster, also has very high amounts of P, Mn, Mg, Ti, and Fe, and high amounts of K and Ca. Sample No. 11, which is related to soil containing large amounts of waster of the kiln, along with a very strong increase in Cl and Na, the amount of elements such as K, Mg, and S has also increased significantly. It seems that the reason for the increase of elements such as Ti and Fe in some Tapeh Zagheh floors (for example, samples number 1, 2, 3, 4, 5) was the use of materials such as ocher mud or fire ash in the composition of these floors. Sample No. 13, which was taken from an oven located in the FIX trench, has very high amounts of Mn, Ti, and Fe, and high amounts of P and Ca. Sample No. 15, which is related to House No. VII (probably related to a pen or a place where animals were kept), has much more phosphate compared to the control samples, which is probably due to the addition of animal excrement and urine to the soil. Sample No. 29 was taken from the north of the industrial area of Zagheh village (place of pottery kilns). The very low amount of index elements in sample No. 29 shows that the industrial activities did not extend to the mentioned point and therefore the range of this point can be considered as the boundary between the residential part of the Zagheh village and its industrial part.

Keywords— Prehistory, Multi-Elemental Analysis, Tapeh Zagheh, XRF

¹ Ph.D. in Archaeology, University of Tehran, Tehran, Iran, (corresponding author, phone: 00989180615339; e-mail: Iraj.Rezaie@ut.ac.ir)

² Department of Archaeology, University of Tehran, Tehran, Iran, (e-mail: kniknami@ut.ac.ir)

Relationship Between Micro-Level Entrepreneurial Resilience with Job Satisfaction and Family Social Support

Kristiana Haryanti, Theresia Dwi Hastuti, Agustine Eva Maria Soekesi

Theresia Dwi Hastuti is with the in Soegijapranata Catholic University, Indonesia (e-mail: theresia@unika.ac.id).

Abstract

Entrepreneurship is an important topic today that is widely discussed in the business world. The COVID-19 pandemic has devastated all businesses in the world, especially businesses at the micro level. This study tries to prove the relationship between job satisfaction of micro-level business owners and family social support on their resilience. The respondents of this study amounted to 58 entrepreneurs. The results of this study indicate that there is a relationship between job satisfaction and social support with entrepreneurial resilience in continuing the family business.

Keyword: Family Business, Family Social Support, Job Satisfaction, Resilience

Research Objectives

to empirically examine the relationship between job satisfaction and family social support with resilience at micro-level entrepreneurship.

Methodology of Research

This study uses quantitative research methods . Analysis using SPSS multiple regression. Data were collected using Likert model, namely The Connor-Davidson Resilience Scale, Family Social Support Scale by Vaux and the Job Satisfaction Scale

Research Contribution

The results of this study are provide more detailed information about what aspects of job satisfaction and family social support are related to entrepreneurial resilience so that they can advise on the development of entrepreneurial sustainability.

Effect of Company Value, Leadership and Ownership Succession on Financial Performance of Family Business

Theressia Dwi Hastuti, Kristiana Haryanti, Agustine Eva Maria Soekesi

Kristiana Haryanti is with the in Soegijapranata Catholic University, Indonesia (e-mail: kristiana@unika.ac.id).

Abstract

Today's family business continues to grow in big cities and in rural areas throughout Indonesia in line with the development of the business world and global competition. This study aims to analyze the effect of company value, leadership and ownership succession on financial performance of family business. The research method was carried out quantitatively with multiple regression. The respondent amounted 63 entrepreneurs. This study found that company value, leadership succession, relationships and communication affect the financial performance of family business.

Keyword: Company Value, Family Business, Financial Performance, Leadership Succession, Ownership Succession

Research Objectives

The purpose of this study is to empirically examine the effect of company value, Leadership succession and ownership succession on the financial performance of family businesses

Methodology of Research

This study uses quantitative research methods with SPSS multiple regression which includes data quality testing and hypothesis testing. The data used is primary data obtained by distributing questionnaires to natural batik entrepreneurs

Research Contribution

This research is expected to contribute for natural batik entrepreneurs that strengthening company value, effectiveness of business management and good ownership will increase the sustainability of family businesses

Online Interior Design Management System

¹hussein Aamir, ² Osman Asia, ³ Collins Oduor Ondiek

¹ Hussein Aamir, Student, Department of Computing, United States International University-Africa, Nairobi, Kenya

² Osman Asia , Student, Department of Computing, United States International University-Africa, Nairobi, Kenya

³ Assistant Professor, School of Science and Technology, United States International University-Africa, Nairobi, Kenya

E-mail: aamirabdirahman00@gmail.com, asiaosman06@gmail.com , coduor@usu.ac.ke,

Abstract

To start with, interior design is generally the art or practice of arranging and directing the plan and execution of design insides and their goods.

Interior design is a process that provides its customers with a set of visually pleasing but efficient solutions for a better use of space. Interior design is normally characterized as the art and study of upgrading the interior of a space to make a cleaned and all the more tastefully satisfying climate. An interior architect is somebody prepared to execute plans, examination, coordinate, and oversee beautifying projects with power. The calling of interior design is fluctuated and incorporates space arranging, theoretical turn of events, site reviews, programming, research, speaking with the customers, venture and development the board, and obviously the execution of the ideal plan (Team, 2021).

Some of the major problems faced with startup interior design companies are lack of exposure, limited use of social media, unauthorized access of user data and complexity of the system. The research objective are to find out the traditional challenges with the old interior design management systems as well as to determine the benefits of the proposed interior design management system. The proposed system will be useful in interior and decoration industry. It connects all the stakeholders involved such as administrator, customers and therefore making it easier to maintain. Automating processes such as package bookings, automatic updates of contents and real-time customer support all over the world via online applications will greatly contribute to information sharing, economic development as well as promoting interior designs and decorations to a greater height.

The response rate is determined by dividing the number of people who completed the questionnaire google forms by the number of people in the research study sample. In this research study, online questionnaires were administered to 35 participants, and only 29 people successfully completed the survey and analysis. This response rate is 83% due to the limited time for response.

The proposed system is highly recommended for implementation in interior design sectors.

This research uses descriptive design, descriptive research involves the description, recording, analysis and interpretation of the present nature, composition, or process of phenomena. The focus is

on the prevailing conditions, on how a person, group, or thing behaves or functions at the time of the study.

Based on this research study, it was concluded that an online interior design management system has proven to be beneficial to those facing interior design management issues.

From the findings, 100% of the respondent proposed the use of this system.

Keywords:i.e Information technology, Best Practice, Information and Communications Technology (ICT), Utilization, ICT Adoption.

1.0 Introduction

1.1 Background of the Study

Interior design is a process that provides its customers with a set of visually pleasing but efficient solutions for a better use of space. Interior design is characterized as the art and study of upgrading the interior of a space to make a cleaned and all the more tastefully satisfying climate. An interior architect is somebody prepared to execute plans, examination, coordinate, and oversee beautifying projects with power. The calling of interior design is fluctuated and incorporates space arranging, theoretical turn of events, site reviews, programming, research, speaking with the customers, venture and development the board, and obviously the execution of the ideal plan (Team, 2021).

1.2 Problem statement

One of the challenges faced with startup interior design companies are **lack of exposure** to customers. Secondly, **limited use of social media** that is; social media may help you to some extent but relying on it alone will not help, as it does not belong to you. **Unauthorized access of user data:** Many existing systems are have not dwelled on advocating for securing user information. The hackers compromising systems and accessing the user confidential data is also a challenge.

Complexity of the system: the current systems are very complex for usage by the users and therefore a lot of money is spent on special training by interior companies. This is because, some systems are very complex for usage and therefore they have to go an extra mile and provide a budget to cater for the training as well as implementation of the system.

1.3 Objectives of the study

1.3.1 Overall goal

To design and develop an online interior design management system.

1.3.2 Specific Research Objectives

Registration and login interface to allow admin functionalities execution.

Report generation module for different stakeholders involved.

Feedback module for clients.

Comment section for stakeholders.

1.4 Research Questions

What are the traditional challenges with the old interior design management systems?

What are the benefits of the proposed interior design management systems?

1.5 Scope of the study

The system will be first implemented to be used within Nairobi County by a startup company called Design IT and it can then later be scaled up and used by different companies in other counties and the long-term scope would be to use this system globally.

The stakeholders involved in this system are the customers who basically make requests on the interior design services and the administrator who manages the entire functionalities of the system.

1.6 Significance of the study

The study contributes to the increasing conversation regarding interior designs as well as decoration systems. This paper is relevant to Sustainable Development Goal (SDG) 11, specifically, to

“SUSTAINABLE CITIES AND COMMUNITIES”,

Making cities sustainable means creating career and business opportunities, safe and affordable housing, and building resilient societies and economies. It involves investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways.

Moreover, a delightfully improved interior design capacities well as it makes a state of mind or an inclination and shows off the character of the family that lives there. Its regard for these three significant fixings —capacity, mind-set and character — that guarantees embellishing achievement (Shari Hiller, 2021).

Prior to painting and reworking, invest some energy pondering your family and how you live. Glance through magazines for motivation and take out thoughts or rooms that allure for you. Assemble things from around the house that cause you to feel better and study them cautiously for shading signs and maybe a piece of information to the disposition you're searching for in your home. This is the start of a very much arranged and designed living region (Shari Hiller, 2021).

2.0 Literature Review

2.1 Introduction

The literature review basically looks at the related works that have been carryout by other researchers. We will also look at the existing systems, looking at our research objectives and the summary of this chapter.

2.2 Literraure revew on based on the specific research objectives

2.2.1 Specific research objective 1

Limited report generation by the system: The existing systems lack reports that can be generated and used for future reference and therefore in case of a failure, it might be difficult to resilience. Therefore, it is very difficult to generate and be able share these reports when the need arises.

Insecurity of user accounts and details: many social networking and especially in higher learning institutions are very prone to attacks by the hackers due to not putting into consideration the elements of securing user data.

Challenge in records maintenance: this is a problem due to manual usage in record keeping for contracts and booking, this makes manual record maintenance even more complex. Manual data

storage is cheap however, it is expensive as many information may be lost probably due to misplacement of documents and files.

Limitation on data sharing: since sharing of information is being done manually, it comes very hectic, it takes a lot of time and resources as well as reaching only a limited number of people. Only a few people will benefit from this. In order to reach out to massive people an added cost is incurred.

Complexity by user experience: some of the existing systems are very complex and difficult to understand them and therefore, companies would require to offer expertized training levels that costs a lot which is a limitation to most systems.

Lack of sufficient support for customers: support for the students and other stakeholders is has not been put into considerations in case of any difficulties and therefore it takes long to see the benefits that the system impacts to the entity.

Poor Performance by most system: Some platforms take too long to give responses to the user requests and therefore they are viewed as annoying and that's a challenge that should be worked on by. This implies that there is slow processing of requests probably while trying to fetch information from the server.

Time consuming when adapting these systems: As much as many systems have adapted to online usage, many of the interior systems haven't therefore the contracts are still generated manually which makes this process very tiresome.

Poor implementation of the user interface: Some of the existing systems are quite basic to an extent, the GUI are not captivating as you would expect. This is poor implementation strategies from the developers or to an extent, poor system design and analysis.

2.2.2 Specific research objective 2

The system is flexible on usage: The system is flexible enough in a way allowing the clients and all the stakeholders of the system to choose the contents they want to access and each content is accessed by authorized users.

Automation of processes: The proposed system will offer automated processes such profile updating, customer support and bookings.

Report generation: The system shall allow the generation of reports by all stakeholders involved. This will help in sharing and future references when the need be.

Crud functionality support on the admin side: Admin will be able to create users, update and upload contents as well as be able to delete contents of the website. More functionalities could be achieved from this.

Diverse awareness on services: The proposed system will be able to reach out to many customers all over the globe. Through optimization and automation, this will be made possible. Massive people all over the world will get this information easily and faster. This could be shared even on other social media platforms.

Assured customer care support: The system allows for automatically calls that can be made 24/7. This will encourage users to book and made inquiries on specific packages. This will build brand loyalty and customer loyalty as well.

Security and confidentiality of user contents: sensitive data of the stakeholders of the system are kept securely. The passwords are hashed and the views are assigned to different users gives the ease to manage the users of the system.

Use of User-friendly graphical user interface: the system will be designed with unique, easy and accessible features that one can navigate through without any complications. Professional designs and implementation have been put in place to make sure the system is capturing the attention of the users and any other stakeholders involved.

2.3 Conclusion

The proposed system will be useful in interior and decoration industry. It connects all the stakeholders involved such as administrator, customers and therefore making it easier to maintain. Automating processes such as package bookings, automatic updates of contents and real-time customer support all over the world via online applications will greatly contribute to information sharing, economic development as well as promoting interior designs and decorations to a greater height. The proposed system is highly recommended for implementation in interior design sectors.

In addition, putting all these in place, it will save a lot of paper work and thus reducing expenses, inconvenience and inconsistence of data and processes in this field.

3.0 Research Design and Methodology

3.1 Locality of the project and Beneficiaries to the project

This system will be implemented in within Kenya boundaries and specifically within Nairobi County. The scope of the study will be expanded based on the success of this system within Nairobi County and the extended to other counties within Kenya and later into other countries.

The beneficiaries of this system include: Interior companies, they are registered on this website and are able to market their products. It will also be beneficial to event planners who will teach who to navigate the whole system. We also Customers; who are basically the end users of this system, they are to view services, make bookings as well as interact with the system. Lastly the system administrator: who manages the system resources such as registration and adding services and products for the company.

3.2 Research approach

In this research, the author uses descriptive design, descriptive research involves the description, recording, analysis and interpretation of the present nature, composition, or process of phenomena. The focus is on the prevailing conditions, on how a person, group, or thing behaves or functions at the time of the study.

The study also involves considering descriptive research design as its intendeds to provide information to systematically describe the system itself. In this case through the research, we will use case studies and even surveys to ensure we effectively describe the intended data problem. The study also involved visiting other interior design companies and their websites for data collection.

3.2 Population of the study(Target group) and Sampling method

This research basically targets Interior design enterprises within Nairobi County, it also looks at the Real estate users as well as individual customers who visit these companies. A simple random sampling method is used to collect data from the above target group.

3.3 Data collection methods and Primary Data collection methods

The collection of data, is by the use of questionnaires generated by the google forms that will be administered to the users of the system.

3.4.1 Primary Data collection methods

For the system, questionnaire is the primary method used for data collection.

3.4.1.1 Online Questionnaire

A well-structured questionnaire was administered to a number of interior design website users and general public, who were able to fill it in order to know the challenges with the old interior design management systems as well as the benefits of the proposed interior design management system.

3.4.2 Secondary data collection methods

These methods consist of data that has already been collected by someone else and passed through a statistical process. They include qualitative and quantitative data collection methods. In addition to this, qualitative methods include the use of newspapers, reports, historical and official documents whereas quantitative methods are international sources where the internet is the major source.

3.4 Data analysis methods

Data collected from the various sources such as online google forms, will be analyzed with simple, descriptive, statistical and analytical tools such as frequencies, percentages, graphs and charts (control, pareto, monitoring, bar, pie etc.).

3.6 Testing plan for the system

For the system, several testing procedures will be conducted ranging from Unit testing for the individual modules so as to eliminate executable and logical errors, an Integration testing will be performed for the dependent modules and finally System testing for the whole system as a whole.

Table 3.1: Tabular Description for the Testing Plan of the system.

Input	Expected actions & Processes	Output

Login validation	Username and password are set by the users	For the Correct password: Logged in to the system successfully For Incorrect password: ID or password Error
Login type	Many types of Users: company manager/administrator and clients.	All the stakeholders have different roles
Administrator/property manager adding properties, users and page content.	Administrator/ property manager adds properties, users and the contents for related pages.	The Administrator can add the properties as well as the page contents that are for user interface view.
System administrator generating results.	From user request, system Administrator can manage user profiles and generate results.	Password changed to a new one and accepts login The previous one invalid
Users general form	Displays all the available booking, login and registration and other available forms.	There are links based on the clicked button and active links on the mobile pages.

Table 1 Tabular Description for the Test Plan

3.7 Ethical clearance considerations

Ethical clearance approval of a research project helps to increase the legitimacy of research findings. This is important for those making decisions based on the research results on my project. In order to implement this proposed system, I will need the approval from different considerate bodies. Some of the documents for approval on my project includes:

- A letter from the program coordinator in the university.
- A letter from the project supervisor.
- A letter from Dean School of science and technology.

4.0 Research findings and analysis

4.1 Response rate

The response rate is determined by dividing the number of people who completed the questionnaire google forms by the number of people in the research study sample. In this research study, online questionnaires were administered to 35 participants, and only 29 people successfully completed the survey and analysis. This response rate is 83% due to the limited time for response.

4.2 Demographics results

5.2.1 Distribution by Age

The responses were majorly distributed among the adult persons. Majority of the respondents were between 21-24 years of age (55.2%), followed by the age bracket between 25 and above at (24.1%) and it was tailed by 18-20 years (20.7%) This shows that individuals from different age groups are interested in the idea of having an Online Interior design management system. The age distribution is a clear indication that the participants of between 21-24 years most probably have a good understanding of the project topic.

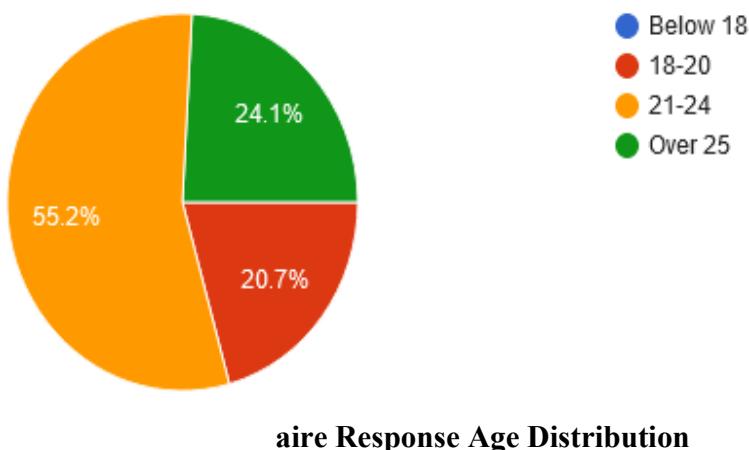


Figure 5
1:
Questionn

aire Response Age Distribution

Source: Author Data 2022

5.2.2 Distribution by Gender

The study's results indicated that 63.3% of the respondents in the survey were Male where as 33.3% female. This indicates an almost even distribution of participants along gender lines, which is an important factor to consider for validating the responses. The pie chart below depicts the gender distribution of the respondents.

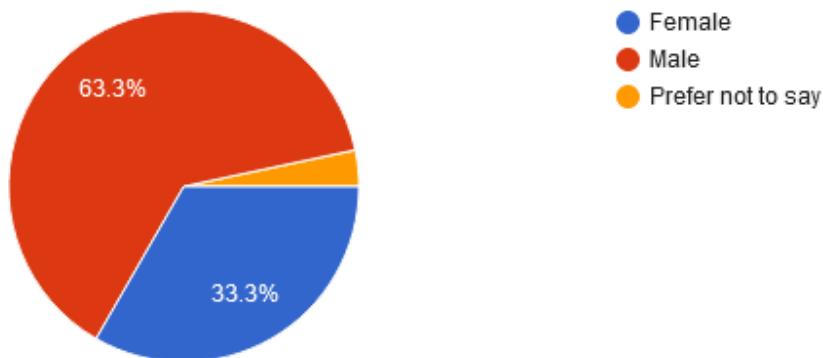


Figure 5 2: Questionnaire Response Gender Distribution

Source: Author Data 2022

5.2.3 Distribution by Locality of Residents

The survey revealed that 61.7% of the respondents lived in an urban setting, 38.7% in rural setting. This data is relevant in determining the likelihood of the respondents having experienced any use of Online Interior design system.

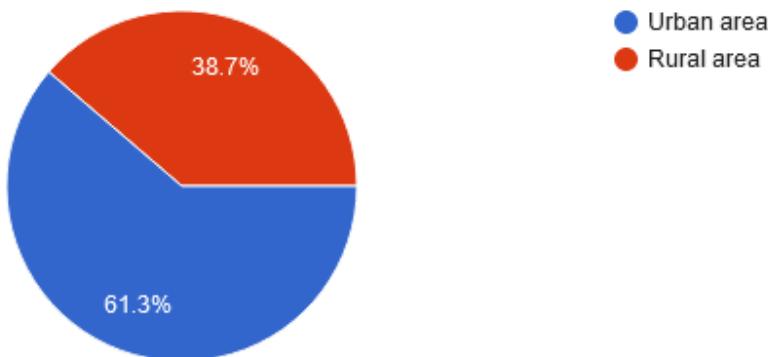


Figure 5 3: Distribution by Locality of Residence

Source: Author Data 2022

5.2.4 Distribution by number of users

The distribution in terms of number of users form the sample population used in the research study a higher population responded at a rate of (64.5%) that have been able to access Online Interior design system and have navigated through it and only (35.5%) have not been able to use the system.

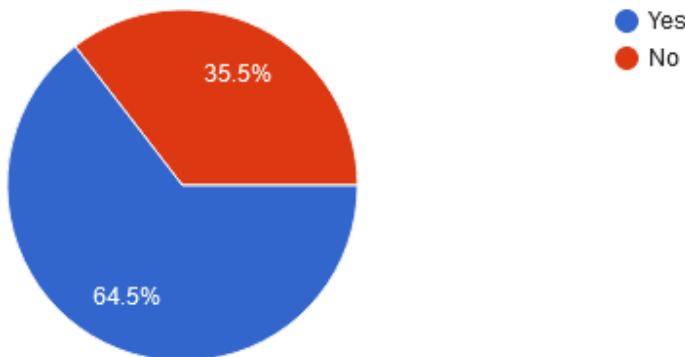


Figure 5 4: Distribution of Number of users of the system

Source: Author Data 2022

5.2.5 Distribution by performance if yes

The Response rate from the ones who have been able to use the online interior design system performance was as both fast and slow as they both held the largest percentage by 37% followed by very fast at a rate of 14.8% and lastly the performance of the system was very slow at a rate of 11.1%.

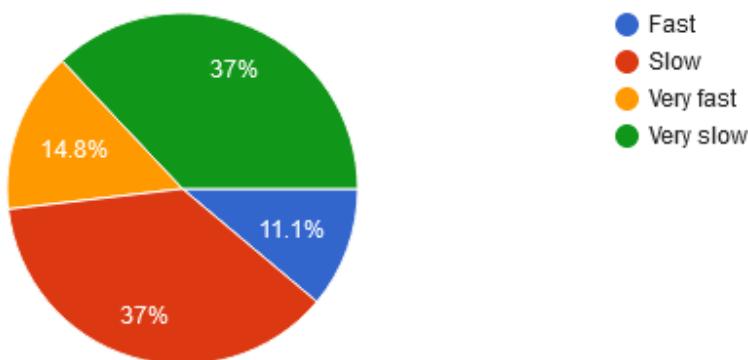


Figure 5 5: Distribution by performance of YES

Source: Author Data 2022

5.2.6 Distribution in terms of access to smartphone or computer devices

The respondent's distribution rate was that a higher number of them were able to have access to smartphone or computer devices with a rate of 96.9% of the total population. This gives the perception in the sense that many people are able to access the interior design online services.

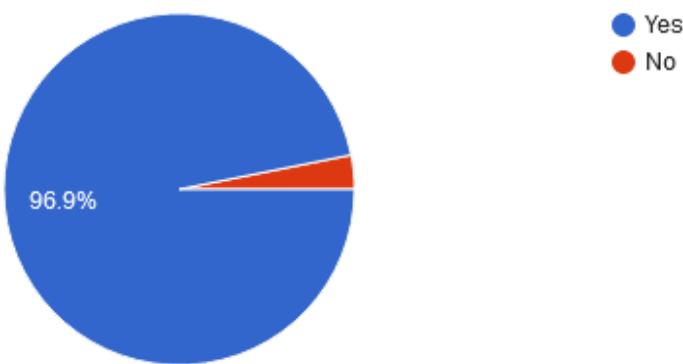
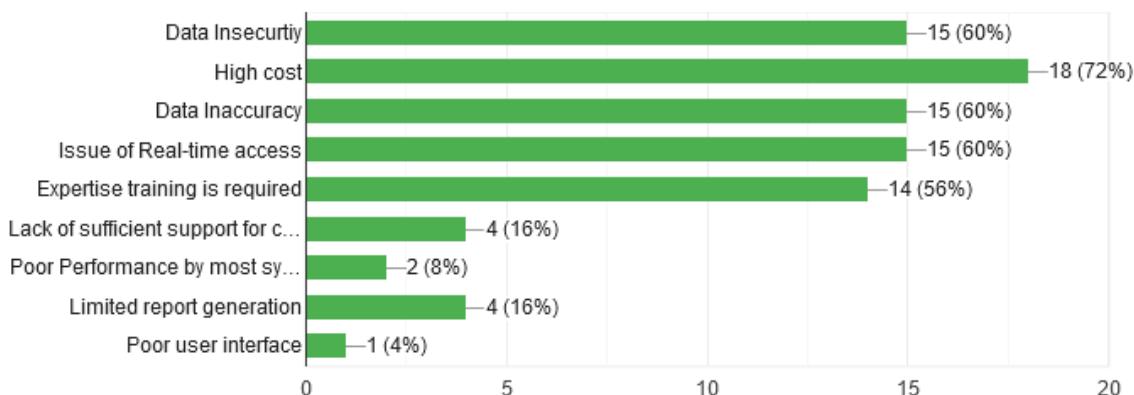


Figure 5 6: Questionnaire distribution by access to smartphone or computer devices

Source: Author Data 2022

4.3 Results of challenges of the old interior design management systems

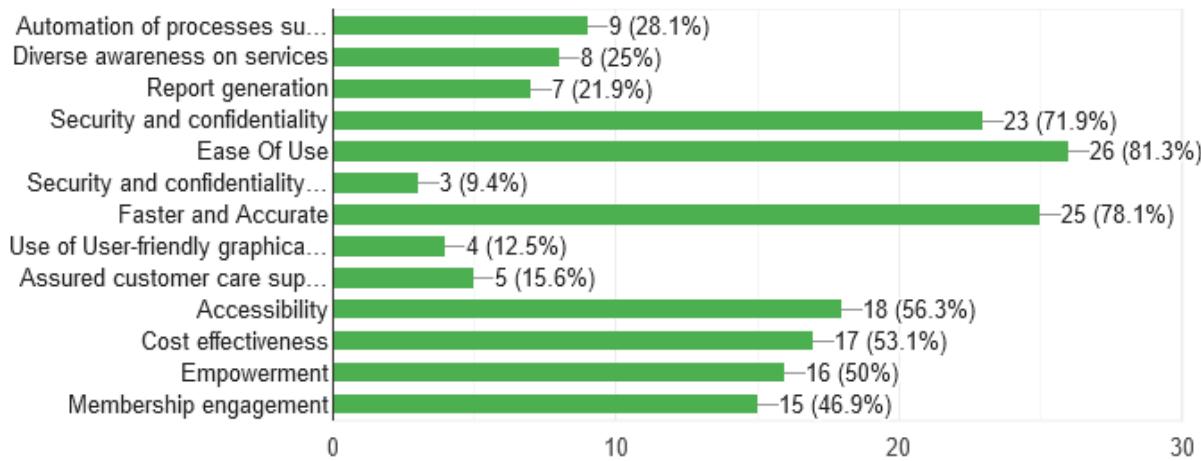
Respondents were asked to select the obstacles that they primarily relate to when using online interior design systems, based on the study's research objectives. 72% of the respondents felt that high cost in using the system is a major challenge to them. 60% of the respondents had challenges with the data insecurity, data inaccuracy and real-time access issues. 56% of the respondent felt that they need expertise training to help in the navigation of the whole system. 16% had problems with lack of quality service and sufficient support for customer. Another group with 16% rate of number also felt that the system generates limited reports. 8% felt that the system performed poorly on their sides, lastly 4% of the respondents felt that the system had poor user interface. The majority of the respondents had challenges high costs and data insecurity and data inaccuracy.



4.4 Results of benefits of the new systems(Online Interior Design Management System)

Respondents were further asked to identify the benefits of Online Interior design Management system of the proposed system that they believe will be included in the final product. Most of the respondents 81.3% of the population were benefited by system since it was easy to use, followed by 78.1% of the respondents also agreed that the system was fast and accurate. 71% and 9.4% of the respondents said yes to the system security and confidentiality. 56% of the respondents agreed that that the system was beneficial in terms of accessibility while 53.1% saw that the system was cost effective thus also beneficial to them. 50% benefited through empowerment, 46.9% agreed to the

System member engagement. 28.1% of the respondents benefited through the automation of the system while 24.2% had a great report generation and diverse awareness on services.



5.0 Discussion conclusion and recommendations

5.1 Discussion

The purpose of the research study on Online Interior design Management system was to gather data on the feasibility of the proposed system and the challenges of working with Online Interior design system in relation to the research objectives. We may infer from the 83 percent participation ratio that Interior design system is a matter that both Male and female individuals relate to and are open to discussing, and according to the demographic statistics, both men and women are comparably engaged in the topic with high percentage of female. The target participants were primarily young adults' people aged 18 to 25 and above years old. At around this age bracket, it is reasonable to expect these individuals understand the Importance and uses of interior design, how it makes them feel valued besides through Interior design most home owners feel rejuvenated and relaxed in their rooms, therefore putting younger people who both own home and who do not own homes participate constructively to the Interior design topic.

5.2 Conclusion

Based on the research study, it can be concluded that an online interior design management system has proven to be beneficial to those facing interior design management issues. It can also be concluded that more people would be open to using an online interior design management service due to various factors such as assured security and confidentiality. The proposed system would therefore be implemented in order to cater for the group of people that require constant interior design services.

5.3 Recommendations

From the findings, it is clear that this system will be well received by most people. The system will help improve the digital services use especially those in interior and decoration sector. From the findings, 100% of the respondent proposed the use of this system.

Additionally, the system will be helping so many people, it will need to be scaled to cater for a larger geographical area than Kenya. This will help expand the reach of property management services and provide an accessible solution to those who need it.

5.4 Future work

To start with, the current proposed system is targeted at the stakeholders within Nairobi County. More research will need to be carried out in order to improve the user experience while using this system. Some of the user experience services to be worked on would include:

- A real-time chatbot for the customer support.
- Scalable storage services such as the use of cloud for user data storage.
- Additional of more video modules for client viewing and interaction with the site.
- Digital payment: Such as the use of credits to make purchases. This can be achieved by the use of API's that have been provided which must be secured for clients use. Example is the use of MPESA API.

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AUTHORS

Authors	Hussein Aamir and Osman Asia , Students, Department of Computing, United States International University-Africa, Nairobi, Kenya E-mail: aamirabdirahman00@gmail.com, asiaosman06@gmail.com Website: http://www.usiu.ac.ke
Co- Author	DR.COLLINS ODUOR ONDIEK - Supervisor 1 Assistant Professor, School of Science and Technology, United States International University-Africa, Nairobi, Kenya E-mail: coduor@usu.ac.ke Website: http://www.usiu.ac.ke

Evaluation of Free Technologies, as Tools for Business Process Management (BPM)

Julio Sotomayor

National University Federico Villarreal

jsotomayor@unfv.edu.pe

Daniel Yucra

National University Federico Villarreal

dyucra@unfv.edu.pe

Jorge Mayhuasca

National University Federico Villarreal

jmayhuasca@unfv.edu.pe

Abstract

The article presents an evaluation of free technologies for business process automation, with emphasis only on tools compatible with the General Public License (GPL). The compendium of technologies was based on promoting a Service-Oriented Enterprise Architecture (SOA) and the establishment of a Business Process Management System (BPMS). The methodology for the selection of tools was Agile UP. This proposal allows businesses to achieve technological sovereignty and independence, in addition to the promotion of service orientation and the development of free software based on components.

Keywords: BPM, BPMS Suite, Open-Source Software, SOA, Enterprise Architecture, Business Process Management

1. Introduction

This work is motivated, as organizations think more about automating their processes using a methodology and a clearly defined standard, a justification for using BPM is the continuous improvement of these business processes, in that context, BPM stands for Business Process Management, which is one of the trends in management using information technologies, which allows a deliberate and collaborative way to systematically manage all business processes of an enterprise.

In order to align technologies with the vision and objectives of the business, it is necessary to establish a reference Enterprise Architecture based on technologies, and these technologies can be free alternatives. The Enterprise Architecture (EA) is the logic of how business processes are organized and articulated with the IT infrastructure to support the business model of an enterprise. The Enterprise Architecture reflects the level of information integration and the normalization or standardization of processes for an

optimal operation of the enterprise. Based on these, BPM works with a service-oriented architecture (SOA), capable of integrating and deploying business processes.

BPM uses modeling standards, such as the BPMN notation, which allows fluid communication with a minimum of effort between business processes and the organization itself.

BPM constitutes a technology management alternative capable of optimizing, automating, and continuously improving the business processes of organizations in view of the fact that processes are dynamic, the organization evolves and changes.

On this occasion, we present an evaluation of the existing tools that work with free licenses and collaborative schemes, which allows us to support the management of business processes from modeling, automation, improvement, and monitoring of business processes.

2. Review of the literature

2.1. Enterprise Architecture

Enterprise Architecture (EA) is the logic of how business processes and IT infrastructure are organized to support an enterprise's business model. The Enterprise Architecture reflects the level of information integration and the standardization of processes for the optimal functioning of the enterprise.

2.2. The Gartner Group model

The Gartner Group model defines the Data, Applications, Integration and Access Points domains, which make up the Information Architecture. On the other hand, the Infrastructure, Systems Management and Security Domains make up the Technical Architecture. In each of these seven domains, there are components, i.e., tools that have been developed specifically to be reused; and patterns, solutions to problems in each domain, using the reusable components.

2.3. Business Process Management (BPM)

For KHAN Rashid, it is the discipline of modeling, automating, managing and optimizing processes to increase the profitability of a business. In this view, the objective of process management is focused on increasing profitability. [4]

2.4 Enterprise Application Integration

EAI, or Enterprise Application Integration, is a set of technologies based on industry standards that allow deliberately articulating and integrating different heterogeneous technological solutions with different mechanisms allowing the use of standards for the coupling and expected solution.

2.5. Service Oriented Architecture

SOA (Service Oriented Architecture) has as its main objective to isolate any application of the technology platform and business processes from the rest of the architecture, simplifying significantly the effort of Enterprise Application Integration (EAI).

2.6 SOA and BPM

On the basis of the ideal applications exposed on the services defined by SOA, there is a need to orchestrate and manage business processes (BPM), which constitutes a paradigm to address business improvement processes, increasing efficiency and facilitating integration.

2.8 XPDL

XML for Process Definition Language (XPDL) is a standardized XML file format that can be used to exchange processing models between tools, it is used to perform portability between different BPMS (Business Process Suites).

2.9 BPEL

Business Process Execution Language (BPEL) is a language defined in XML that is designed to orchestrate processes automatically.

2.10 BPMS

Business Process Management Suites (BPMS) are technological tools that contain different components to streamline the modeling, execution, deployment, automation, improvement and monitoring of business processes.

2.11. Process Life Cycle

Business processes have a life cycle (see Figure 1), BPM supports this cycle in each of the phases specified, with its different components: BPA (Business Process Analyses) for the definition, modeling and simulation of business processes; BRE (Business Rules Engine) and Business Process Execution Engine (BPE) enable the implementation and execution of business processes; finally, BAM (Business Activity Monitoring) monitors, analyzes and optimizes business processes.

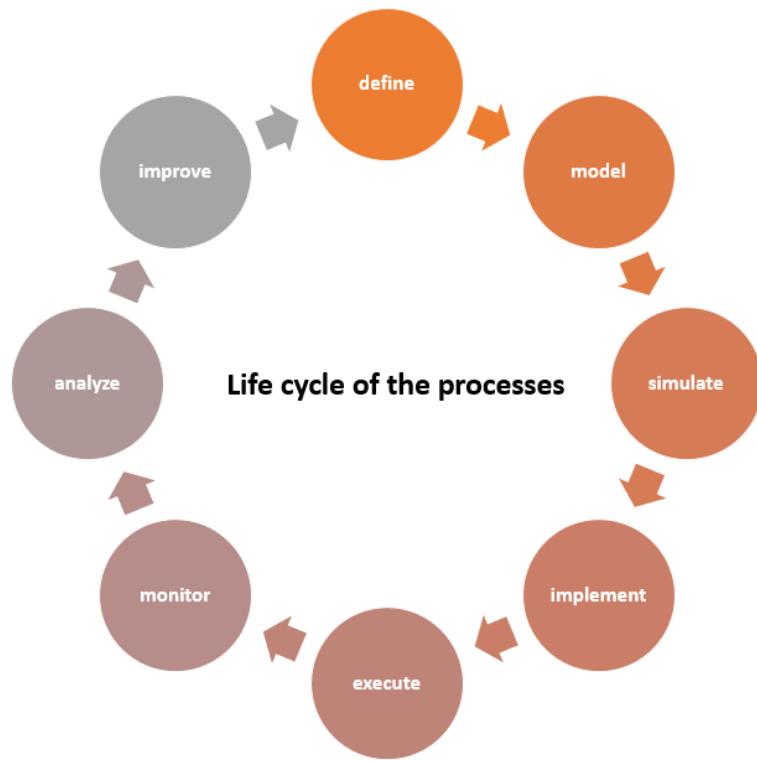


Figure 1. Life cycle of a business process

Source: Own elaboration

3. Problem definition/formulation

The high cost of BPMS solutions, and the growing demand for free solutions to manage business processes, it is necessary for a medium or small business to select a tool that allows to design, automate, monitor and improve business processes. Many businesses use different solutions with free licenses and the constant evolution of BPMS that are incorporating better design mechanisms, automated tools, intuitive business rules engines and components that allow you to monitor processes in execution times in order to constantly improve and innovate business processes.

4. Method of analysis

Business Process Management (BPM) induces analysts to align Information Technology systems with strategic goals, creating well-defined enterprise business processes, monitoring their performance, and optimizing them for greater operational efficiencies. [7]

In addition, BPM enables change management to improve business processes, unifies disciplines such as Workflow Simulation, Enterprise Application Integration (EAI) and business-to-business (B2B) integration into a single standard.

Business Process Management Systems (BPMS) are suites that allow modeling, simulating, implementing, executing, monitoring, analyzing and optimizing business processes using XPDL (XML Process Definition Language), a language for the definition of a Workflow. [8]

From that point of view, it focuses on comparing different free and open-source software solutions that support technologies such as SOA, EAI, XPDL and BPEL, so that they can be considered by companies as viable alternatives and incorporate them within their Technological Architecture.

5. Results and discussion

5.1 Results obtained

Tool evaluation and selection

Once the Enterprise Architecture and the architecture of the business processes on which the use of the BPMS based on free software will be determined, a matrix of criteria was created that will allow the selection of these technologies.

For the evaluation of BPMS technologies based on free software and according to the proposed enterprise architecture, 7 criteria formulated by Forrester [6] were established, and 4 products developed with free technologies were selected: Process Maker, BonitaSoft, and JBoss BPM.

Table 1. BPMS products based on free software evaluated

Evaluated product	Tested version	Tested Operating System	Download URL	BPMS Logo
Process Maker [11]	v 3.2 (Stable)	Linux Generic or Fedora Linux v.33	https://cutt.ly/yEUJ5nr	 ProcessMaker Workflow Simplified
BonitaSoft [12]	2021.2-u0 Community Edition	Linux Generic or Fedora Linux v.33	https://cutt.ly/CEUKvqL	 bonitasoft open your processes
JBPM [13]	7.59	Linux Generic or	https://cutt.ly/DEULsfG	

		Fedora Linux v.33		
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Source: Own elaboration

The following are the technological and licensing characteristics of the suites evaluated:

Table 2. Technological characteristics of free BPMS suites

Evaluated product	License	Language	Database	Container
Process Maker	GNU Affero General Public License version- versión 3	PHP	MYSQL	It does not have
BonitaSoft Studio	Community Apache Public License (CPAL)	Java / JSP	MYSQL	Tomcat
JBPM	Apache License 2.0	Java/ JSP	MySQL	Tomcat

Source: Own elaboration

The criteria were assigned a weighting, according to The Forrester Wave™ (2019) [10]:

Range of evaluations according to Forrester:	
Score	Level
25	Fair
50	Good
75	Very Good
100	Excellent

Finally, the Agile UP methodology was applied for the use and development of a database application, using BPMS, obtaining the following results:

Table 3. Evaluation of Open Source BPMS Technologies

Criteria to consider	Process Maker	BonitaSoft Studio	JBPM
Design	100	100	50
Automation	100	100	75
WorkFlow Experience	50	100	75
Administration and Monitoring	100	75	50
Analysis and optimization	100	100	75

Product Architecture	50	75	100
Market presence	75	75	25
Score Obtained	575	625	450

Source: Own elaboration

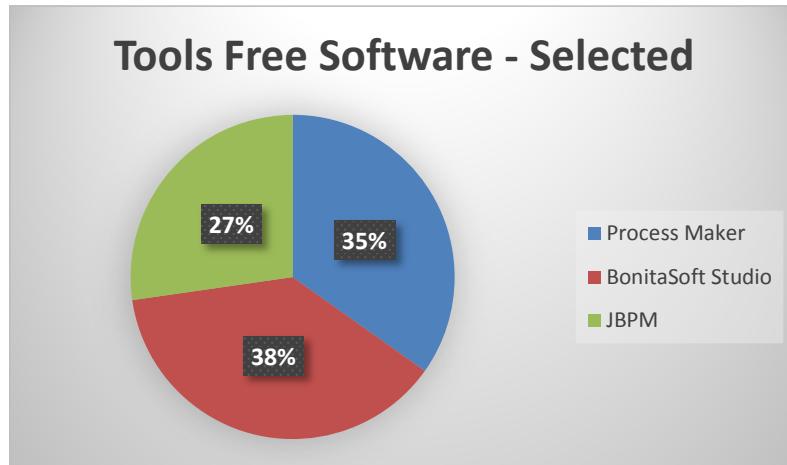


Figure 2. Scores obtained according to evaluation criteria

5.2. Discussion

Taking into account the results of Table 3 and Figure 2, it was decided to choose and select the free information technology offered by BonitaSoft Studio in its Community Edition version under CPAL license.

Bonita Soft, uses a persistence model capable of connecting different database managers, in this case, it supports MySQL, MariaDB and PostgreSQL, free alternatives that allow having free licenses for the community.

In the case of the operating system, it was decided to install BonitaSoft Studio on Fedora Core 25, which is suitable and adaptable to any enterprise architecture.

Another feature of BonitaSoft Studio is that it supports Windows, MacOS and Linux platforms.

The BPMS technologies, legally evaluated, are compatible with Free Software licenses (GNU/GPL) and Open-Source licenses.

6. Conclusions

This choice for the free solution BonitaSoft Studio, constitutes a complementary part of the process management, standardization, management and innovation of processes, aligned with the business strategy ensures the effectiveness of the process and creates an added value in the productive chain of business.

BPM perfectly articulates business processes, strategies and technologies becoming a paradigm of analysis, design and development-oriented processes.

BPM uses modeling standards such as the BPMN notation that allows fluid communication with a minimum of effort between business processes and the organization itself.

BPM constitutes a technology management alternative capable of optimizing, automating and continuously improving the business processes of organizations today facing a highly competitive and changing market.

BPM and BonitaSoft Studio constitute a viable, sustainable and highly eligible technological alternative for organizations that want to automate their processes and open lines of research in the improvement of their methodology, methods, techniques, continuous process management.

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An Elaboration Likelihood Model to Evaluate Consumer Behavior on Facebook Marketplace: Trust on Seller as a Moderator

Sharmistha Chowdhury, Shuva Chowdhury

Abstract— Buying-selling new as well as second-hand goods like tools, furniture, household, electronics, clothing, baby stuff, vehicles, and hobbies through the Facebook marketplace has become a new paradigm for c2c sellers. This phenomenon encourages and empowers decentralised home-oriented sellers. This study adopts Elaboration Likelihood Model (ELM) to explain consumer behaviour on Facebook Marketplace (FM). ELM suggests that consumers process information through the central and peripheral routes, which eventually shape their attitudes towards posts. The central route focuses on information quality, and the peripheral route focuses on cues. Sellers' FM posts usually include product features, prices, conditions, pictures, and pick-up location. This study uses information relevance and accuracy as central route factors. The post's attractiveness represents cues and creates positive or negative associations with the product. A post with remarkable pictures increases the attractiveness of the post. So, post aesthetics is used as a peripheral route factor. People influenced via the central or peripheral route forms an attitude that includes multiple processes – response and purchase intention. People respond to FM posts through save, share and chat. Purchase intention reflects a positive image of the product and higher purchase intention. This study proposes trust on sellers as a moderator to test the strength of its influence on consumer attitudes and behaviour. Trust on sellers is assessed whether sellers have badges or not. A sample questionnaire will be developed and distributed among a group of random FM sellers who are selling vehicles on this platform to conduct the study. The chosen product of this study is the vehicle, a high-value purchase item. High-value purchase requires consumers to consider forming their attitude without any sign of impulsiveness seriously. Hence, vehicles are the perfect choice to test the strength of consumers attitudes and behaviour. The findings of the study add to the elaboration likelihood model and online second-hand marketplace literature.

Keywords— consumer behaviour, elaboration likelihood model, facebook marketplace, c2c marketing.

Sharmistha Chowdhury is with the in Victoria University of Wellington, New Zealand (e-mail: sharmistha.chowdhury10@gmail.com).

Effect of Fiscal Policy on Growth in India

Parma Chakravarti

Abstract— The impact of government spending and taxation on economic growth has remained a central issue of fiscal policy analysis. There is a wide range of opinions over the strength of fiscal policy's effect on macroeconomic variables. It can be argued that the impact of fiscal policy depends on the structure and economic condition of the economy. This study makes an attempt to examine the effect of fiscal policy shocks on growth in India using the structural vector autoregressive model (SVAR), considering data from 1950 to 2019. The study finds that government spending is an important instrument of growth in India, where the share of revenue expenditure to capital expenditure plays a key role. The optimum composition of total expenditure is important for growth and it is not necessarily true that capital expenditure multiplier is more than revenue expenditure multiplier. The study also finds that the impact of public economic activities on private economic activities for both consumption expenditure and gross capital formation of government crowds in private consumption expenditure and private gross capital formation, respectively, thus indicating that government expenditure complements private expenditure in India.

Keywords— government spending, fiscal policy, multiplier, growth.

Determinants of Financial Performance of South African Businesses in Africa: Evidence from JSE Listed Telecommunications Companies

Nomakhosi Tshuma, Carley Chetty

Abstract— This study employed panel regression analysis to investigate the financial performance determinants of MTN and Vodacom's rest of Africa businesses between 2012 to 2020. It used net profit margin, return on assets (ROA), and return on equity (ROE) as financial performance proxies. Financial performance determinants investigated were asset size, debt ratio, liquidity, number of subscribers, and exchange rate. Data relating to exchange rates were obtained from the World Bank website, while financial data and subscriber information were obtained from the companies' audited financial statements. The study found statistically significant negative relationships between debt and both ROA and net profit, exchange rate and both ROA and net profit, and subscribers and ROE. It also found significant positive relationships between ROE and both asset size and exchange rate. The study recommends strategic options that optimise on the above findings, and these include infrastructure sharing to reduce infrastructure costs and the minimisation of foreign-denominated debt.

Keywords— financial performance, determinants of financial performance, business in Africa, telecommunications industry.

Carley Chetty is with the in University of Johannesburg, South Africa (e-mail: carleycumming@gmail.com).

Action of Completely 0-Simple Semigroups on Lattices

Alanka Thomas¹ and P.G. Romeo²

Abstract. K.S.S. Nambooripad introduced a group lattice (G-lattice) as one afforded by the action of a group on a lattice ([7], 1990), ([9], 2022). Here we extend this idea to the action of semi-groups on lattices. This is in par with Donald B. McAlister's ob-servation that certain linear representations of a group extend to a linear representation of a completely 0-simple semigroups (cf.[6], 1971).

1. Introduction

An action of a group G , on any algebraic structure, gives a way to represent G by automorphisms of the respective structure. K.S.S. Nambooripad introduced the action of a group on a lattice and he described the resulting structure as a group lattice (G-lattice). In par-ticular Nambooripad was interested in the study of group actions on arguesian geomodular lattices and he obtained interesting results on the action of groups on such lattices (see [7], 1990).

A semigroup action on lattices is a generalization of G-lattices, since semigroup actions are always an extension of group actions to a broad domain. The action of a semigroup on lattice affords the structure which we call a semigroup lattice (S-lattice). As the set of endomor-phisms on an algebraic structure is a semigroup under composition, each action of a semigroup S represents S by endomorphisms of the given structure. Here one can observe a one-one correspondence be- tween S-lattices and representations of S by lattice endomorphisms. In this paper, we discuss the semigroup lattices of completely 0-simple semigroups, which is a semigroup with zero whose only ideals are $\{0\}$ and itself and has a primitive idempotent.

Rees matrix semigroup $S = {}^0\mathbb{G}; I, \Lambda; P$ is a semigroup with zero whose elements are $I \times \Lambda$ matrices over $\mathbb{G} \cup \{0\}$ having utmost one nonzero entry. P is a $\Lambda \times I$ matrix over $\mathbb{G} \cup \{0\}$ and the binary oper- ation in S is sandwich multiplication with respect to P . If $P = [p_{\lambda i}]$,

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each $p_{\lambda i} = 0$ gives a subgroup $H_{i\lambda} \cong G$. Rees theorem characterizes completely 0-simple semigroups by regular Rees matrix semigroups.

In 1971, Donald B. McAlister studied linear representations of completely 0-simple semigroups and he observed that every linear representation of $S = \text{Inv}^0(G; I, \Lambda; P)$ induces a linear representation of G . He also noted that there are certain linear representations of G that can be extended to a linear representation of S and he called them extendable representations ([6], 1971). While studying S -lattices over completely 0-simple semigroups, we observe the same thing here also. That is every S -lattice of $S = \text{Inv}^0(G; I, \Lambda; P)$ induce a G -lattice and there are certain G -lattices which can be extended to an S -lattices. This is illustrated using the S_3 -lattice $L(S_3)$, the lattice of all subgroups of S_3 , where S_3 acts by conjugation.

This paper consists of two sections. In the first section we define semigroup lattice with an example, few results required for the main theorem is also given in the first section. Semigroup lattices over completely 0-simple semigroups is discussed in the second section.

2. Semigroup lattices

Semigroup actions arise as a generalization of group actions. K.S.S. Nambooripad introduced the action of a group on lattices and he termed the resulting structure a G -lattice ([7], 1990). In this section, we extend this concept to S -lattices.

Definition 1. Let S be a semigroup and (L, \leq, \vee, \wedge) be a lattice. An action of S on L is a map $(s, m) \rightarrow sm \in L$ where $s \in S$ and $m \in L$ satisfies the following for each $s, t \in S$ and $m, n \in L$.

- (1) $s(tm) = (st)m$
- (2) $m \leq n$ implies $sm \leq sn$
- (3) $s(m \vee n) = sm \vee sn$
- (4) $s(m \wedge n) = sm \wedge sn$

L is called an S -lattice. A semigroup lattice is an S -lattice for some semigroup S .

Consider the lattice $L(Z) = \{nZ \mid n \in N\}$ of all principal ideals of Z with the usual inclusion, $mZ \vee nZ = \text{gcd}(m, n)Z$ and $mZ \wedge nZ = \text{lcm}(m, n)Z$. The semigroup N under multiplication acts on $L(Z)$ by $a(mZ) = (am)Z$ and satisfies the following.

- (1) $a(b(nZ)) = a(bn)Z = (ab)nZ$
- (2) $mZ \subseteq nZ$ implies $(am)Z \subseteq (an)Z$
 - (3) $a(mZ \vee nZ) = a(\text{gcd}(m, n)Z) = \text{gcd}(am, an)Z = amZ \vee anZ$
 - (4) $a(mZ \wedge nZ) = a(\text{lcm}(m, n)Z) = \text{lcm}(am, an)Z = amZ \wedge anZ$

hence $L(Z)$ is an N -lattice.

A semigroup action gives a representation of S by endomorphisms of the respective structure. Analogous result for S -lattices is given below.

Theorem 1. Let S be a semigroup and L be a lattice. Then, L is an S -lattice if and only if there exists a representation Γ of S by endomorphisms on L .

Proof. Let $\Gamma : S \rightarrow \text{End}(L)$ be a representation of S by lattice homomorphisms on L . For $s \in S$ and $m \in L$ define $sm = \Gamma(s)(m)$. Since Γ is a representation and each $\Gamma(s)$ is a lattice homomorphism, the above product satisfies properties (1) to (4) of Definition:1 and so L is an S -lattice.

Conversely, let L be an S -lattice. For each $s \in S$ define $\Gamma(s) : L \rightarrow L$ such that $\Gamma(s)(m) = sm$. Since this is an action of S on L , each $\Gamma(s)$ preserves the ordering, meet and join of L and so it is a lattice homomorphism. Also $\Gamma : S \rightarrow \text{End}(L)$, which takes each $s \in S$ to $\Gamma(s)$ is a representation of S .

It can be seen that if T is a subsemigroup of S , every S -lattice L is also a T -lattice. Moreover even when T is subgroup of S , the resulting T -lattice L need not be a group lattice ([9], 2022), but there exists a sublattice of L which is a group lattice under T . This observation is given below.

Lemma 1. Let S be a semigroup and G be a subgroup of S . Then each S -lattice L gives rise to a G -lattice on a sublattice of L .

Proof. Let L be an S -lattice. $L_e = \{em \mid m \in L\}$ be the set of all elements in L moved by the identity e in G . L_e is a sublattice of L , where $em \leq en$ whenever $m \leq n$, $em \vee en = e(m \vee n)$ and $em \wedge en = e(m \wedge n)$. The restriction of the action to $G \times L_e$ gives an action of the group G on L_e and hence L_e is a G -lattice.

Consider $S = \bigcup_{\alpha \in \Omega} S_\alpha$, a decomposition of a semigroup S into disjoint

subsemigroups such that for each $\alpha, \beta \in \Omega$ there exists $\gamma \in \Omega$ such that $S_\alpha S_\beta \subseteq S_\gamma$ ([2], 1961). Ω is a band under the binary operation defined by $\alpha\beta = \gamma$ whenever $S_\alpha S_\beta \subseteq S_\gamma$. We say that S is the union of the band Ω of semigroups S_α . If Ω is a commutative band, S is said to be the union of semilattice Ω of semigroups S_α or simply a semilattice of semigroups. If each S_α is a group, $S = \bigcup_{\alpha \in \Omega} S_\alpha$ is called a band of

groups. If a semigroup is a band of groups, the action of these groups on a lattice gives rise to an action of the semigroup and it is discussed below.

Remark 1. If $S = \bigcup_{\alpha \in \Omega} G_\alpha$ be a union of band Ω of groups. By

Lemma:1, each S -lattice gives G_α -lattices for each α .

Theorem 2. $S = \bigcup_{\alpha \in \Omega} G_\alpha$ be a band of groups and let L be G_α -lattice for all $\alpha \in \Omega$, with the action $g *_\alpha m \in L$ for $g \in G_\alpha$ and $m \in L$.

Then for $\alpha, \beta, \gamma \in \Omega$ such that, $G_\alpha G_\beta \subseteq G_\gamma$, the lattice L is an S -lattice subject to the action

$$(1) \quad s *_{\alpha} (t *_{\beta} m) = (st) *_{\gamma} m$$

for $s \in G_\alpha, t \in G_\beta$

Proof. Let $S = \bigcup_{\alpha \in \Omega} G_\alpha$ be a band of groups and L be G_α -lattice for all

α such that $s *_{\alpha} (t *_{\beta} m) = (st) *_{\gamma} m$. For $s \in S$ and $m \in L$, define $s * m = s *_{\alpha} m$ whenever $s \in G_\alpha$. Then for $s \in G_\alpha, t \in G_\beta$ such that $G_\alpha G_\beta \subseteq G_\gamma$, we have,

$$(1) s * (t * m) = s *_{\alpha} (t *_{\beta} m) = st *_{\gamma} m = st * m$$

$$(2) m \leq n \text{ implies } s *_{\alpha} m \leq s *_{\alpha} n \text{ which means } s * m \leq s * n$$

$$(3) s * (m \vee n) = s *_{\alpha} (m \vee n) = s *_{\alpha} m \vee s *_{\alpha} n = s * m \vee s * n$$

$$(4) s * (m \wedge n) = s *_{\alpha} (m \wedge n) = s *_{\alpha} m \wedge s *_{\alpha} n = s * m \wedge s * n$$

so $*$ is an action of S on L and L is an S -lattice.

An illustration of the theorem is the following example.

Example 1. Let $S_3 = \{\rho_0, \rho_1, \rho_2, \mu_1, \mu_2, \mu_3\}$ be the symmetric group on 3 letters where ρ 's are rotations and μ 's stand for reflections. Consider $C_3 = \{e, a, a^2\}$, the cyclic group of order 3, generated by a . Since C_3 is isomorphic with the alternating group A_3 , there is a homomorphism $\varphi : C_3 \rightarrow S_3$ such that, $\varphi(e) = \rho_0$, $\varphi(a) = \rho_1$ and $\varphi(a^2) = \rho_2$.

$S = S_3 \cup C_3$ is a semigroup with respect to the following binary operation.

$$s \circ t = \begin{cases} st & \text{if } s, t \in S_3 \text{ or } s, t \in C_3; \\ s\varphi(t) & \text{if } s \in S_3 \text{ and } t \in C_3; \varphi(s)t \\ & \text{if } s \in C_3 \text{ and } t \in S_3 \end{cases}$$

The composition table is,

	S_3	C_3
S_3	S_3	S_3
C_3	C_3	C_3

Clearly, S is a semilattice of groups and so, S is a Clifford semigroup. It is known that, the lattice $L(S_3)$ of all subgroups of S_3 is an S_3 -lattice under conjugation ([9], 2022). That is for $g \in S_3$ and $H \in L(S_3)$, the action is $g *_1 H = gHg^{-1}$. We can define an action of C_3 on $L(S_3)$ using the homomorphism φ , as follows. For $g \in C_3$ and $H \in L(S_3)$, define $g *_2 H = \varphi(g)H\varphi(g)^{-1}$. $L(S_3)$ is a C_3 -lattice with respect to this action. For $s, t \in S$, we have the following four cases.

(1) If $s, t \in S_3$,

$$s *_1 (t *_1 H) = s(tHt^{-1})s^{-1} = (st)H(st)^{-1} = (s \circ t) *_1 H.$$

(2) If $s \in S_3$ and $t \in C_3$,

$$s *_1 (t *_2 H) = s(\varphi(t)H\varphi(t)^{-1})s^{-1} = (s \circ t)H(s \circ t)^{-1} = (s \circ t) *_1 H.$$

(3) If $s \in C_3$ and $t \in S_3$,

$$s *_2 (t *_1 H) = \varphi(s)(tHt^{-1})\varphi(s)^{-1} = (s \circ t)H(s \circ t)^{-1} = (s \circ t) *_1 H.$$

(4) If $s, t \in C_3$,

$$s *_2 (t *_2 H) = \varphi(s)(\varphi(t)H\varphi(t)^{-1})\varphi(s)^{-1} = \varphi(st)H\varphi(st)^{-1} = st *_2 H = (s * t) *_2 H.$$

Hence the actions $*_1$ and $*_2$ satisfies Equation:1 of Theorem:2. So they together gives an action of S on $L(S_3)$, so that $L(S_3)$ is an S -lattice.

3. Action of a completely 0-simple semigroup on lattices

A Rees matrix semigroup $S = \mathbb{M}(G; I, \Lambda; P)$ is a semigroup whose elements are $I \times \Lambda$ matrices over $G \cup \{0\}$ having atmost one nonzero entry and the binary operation is sandwich matrix multiplication with $P = (p_{\lambda i})_{\Lambda \times I}$. The matrix $P = (p_{\lambda i})_{\Lambda \times I}$ is called the sandwich matrix and a sandwich matrix having its unique nonzero entry $g \in G$ at the $(i, \lambda)^{\text{th}}$ position can be identified as the triplet (g, i, λ) . The binary operation is given by,

$$(g, i, \lambda)(h, j, \mu) = \begin{cases} (gp_{\lambda j}h, i, \mu) & \text{if } p_{\lambda j} \neq 0; \\ 0 & \text{otherwise.} \end{cases}$$

The matrix P is said to be regular if each row and each column of P has atleast one nonzero entry. A regular Rees matrix semigroup is a Rees matrix semigroup with regular sandwich matrix. Rees theorem characterizes completely 0-simple semigroups by regular Rees matrix semigroups ([5], 1995).

In the following we consider the with semigroup lattices of completely 0-simple semigroups. Let S be a sompletely 0-simple semigroup. For $p_{\lambda i} = 0$, $H_{i\lambda} = \{(g, i, \lambda) \mid g \in G\}$ is a subgroup of S isomorphic with G . Using Lemma: 1, every S -lattice L gives an $H_{i\lambda}$ -lattice on a sublattice $L_{i\lambda}$ of L . As $H_{i\lambda} \cong G$, this action provides an action of G on $L_{i\lambda}$, so that $L_{i\lambda}$ is a G -lattice.

In 1971 Donald B. McAlister proved that every linear representation Γ of $S = \mathbb{M}(G; I, \Lambda; P)$, a completely 0-simple semigroup induce a linear representation γ of G and Γ can be reconstructed in terms of γ . Conversely there are certain linear representations γ of G which can be extended to a representation of S . He termed γ^0 's with this property as extendable representations ([6], 1971). It is already seen that every G -lattice gives a representation of G by lattice automorphisms and every S -lattice gives a representation of S by lattice endomorphisms. Now our aim is to have an observation analogous to that of D.B. McAlister, in lattice theoretic terms (Theorem:3).

Theorem 3. *Let $S = M(G; I, \Lambda; P)$ be a completely 0-simple semi- group. Consider the S -lattice L and $\Gamma : S \rightarrow \text{End}(L)$ be the representation of S on L . For $p_{\lambda i} = 0$, let L^0 be a G -lattice equivalent to the G -lattice $L_{i\lambda}$, and $\gamma : G \rightarrow \text{Aut}(L^0)$ be the representation. Then there exist lattice homomorphisms $R_j : L^0 \rightarrow L$ and $Q_\mu : L \rightarrow L^0$ such that $Q_\mu R_j = \gamma(p_{\mu j})$ and $\Gamma(g, j, \mu) = R_j \gamma(g) Q_\mu$ for all $(g, j, \mu) \in S$.*

Conversely, let $\gamma : G \rightarrow \text{Aut}(L^0)$ be a representation corresponding to a G -lattice L^0 . Consider the lattice L admitting lattice homomorphisms $R_j : L^0 \rightarrow L$ and $Q_\mu : L \rightarrow L^0$ such that $Q_\mu R_j = \gamma(p_{\mu j})$. Then $\Gamma : S \rightarrow \text{End}(L)$ such that $\Gamma(g, j, \mu) = R_j \gamma(g) Q_\mu$ for all $(g, j, \mu) \in S$, defines an action of S on L . Further, the G -lattice L_{ij} is equivalent to the G -lattice L^0 .

Proof. Let $S = M(G; I, \Lambda; P)$ be a completely 0-simple semigroup and L be an S -lattice. For $p_{\lambda i} = 0$ the group H_{ij} is isomorphic with G and by Lemma 1, $L_{ij} = \{(p_{\lambda i}^{-1}, i, \lambda)m \mid m \in L\}$ is a G -lattice. The representation associated with the G -lattice L_{ij} be $\gamma_{ij} : G \rightarrow \text{Aut}(L_{ij})$, which is the composition of the isomorphism between G and H_{ij} and the restriction of Γ into H_{ij} . Let L^0 be any G -lattice isomorphic with L_{ij} and $\gamma : G \rightarrow \text{Aut}(L^0)$ be the associated representation of G . Then there exist an isomorphism $\alpha : L_{ij} \rightarrow L^0$ such that $\gamma_{ij}(g) = \alpha^{-1}\gamma(g)\alpha$ for all $g \in G$. Let $s = (g, j, \mu)$ be any element in S . If e denotes the identity in G ,

$$s = (e, j, \lambda)(p_{\lambda i}^{-1}g, i, \lambda)(p_{\lambda i}^{-1}, i, \mu).$$

So

$$\begin{aligned} \Gamma(s) &= \Gamma(e, j, \lambda)\Gamma(p_{\lambda i}^{-1}g, i, \lambda)\Gamma(p_{\lambda i}^{-1}, i, \mu) \\ &= \Gamma(e, j, \lambda)\gamma_{ij}(g)\Gamma(p_{\lambda i}^{-1}, i, \mu) \\ &= \Gamma(e, j, \lambda)\alpha^{-1}\gamma(g)\alpha\Gamma(p_{\lambda i}^{-1}, i, \mu) \\ &= R_j\gamma(g)Q_\mu \end{aligned}$$

where $R_j = \Gamma(e, j, \lambda)\alpha^{-1} : L^0 \rightarrow L$ and $Q_\mu = \alpha\Gamma(p_{\lambda i}^{-1}, i, \mu) : L \rightarrow L^0$. Then

$$\begin{aligned} Q_\mu R_j &= \alpha\Gamma(p_{\lambda i}^{-1}, i, \mu)\Gamma(e, j, \lambda)\alpha^{-1} \\ &= \alpha\Gamma(p_{\lambda i}^{-1}p_{\mu j}, i, \lambda)\alpha^{-1} \\ &= \alpha\gamma_{ij}(p_{\mu j})\alpha^{-1} = \gamma(p_{\mu j}). \end{aligned}$$

Conversely assume that L^0 is a G -lattice and $\gamma : G \rightarrow \text{Aut}(L^0)$ be the corresponding representation. Also assume that, for each $j \in I$ and $\mu \in \Lambda$, $R_j : L^0 \rightarrow L$ and $Q_\mu : L \rightarrow L^0$ are lattice morphisms such that such that $Q_\mu R_j = \gamma(p_{\mu j})$ for some lattice L . Since P is a regular matrix, each row and each column of P has atleast one nonzero entry. Hence for each R_j there exist a Q_μ such that $Q_\mu R_j$ is invertible and so R_j is injective. Using the same argument it can be seen that each Q_μ is surjective.

Define $\Gamma : S \rightarrow \text{End}(L)$ such that, for each $s = (g, j, \mu)$ in S ,

$$\Gamma(s) = R_j\gamma(g)Q_\mu.$$

Γ is a representation of S by lattice homomorphisms on L and hence L is an S -lattice. The restriction of Γ into H_{ij} gives a G -lattice structure on L_{ij} with $\gamma_{ij} : G \rightarrow \text{Aut}(L_{ij})$ as the associated representation. We need to show that the G -lattices L and L_{ij} are isomorphic. We have,

$$L_{ij} = \Gamma(p_{\lambda i}^{-1}, i, \lambda)(L) = R_i\gamma(p_{\lambda i}^{-1})Q_\lambda(L) = R_i\gamma(p_{\lambda i}^{-1})L^0$$

since Q_λ is surjective. Since R_i and $\gamma(p_{\lambda i}^{-1})$ are injective, so is their composition, hence the corestriction of $R_i \gamma(p_{\lambda i}^{-1})$ into $L_{i\lambda}$ is a lattice isomorphism between L^0 and $L_{i\lambda}$. Let it be denoted by η . Now,

$$\begin{aligned}\gamma_{i\lambda}(g)\eta &= R_i \gamma(p_{\lambda i}^{-1} g) Q_\lambda R_i \gamma(p_{\lambda i}^{-1}) \\ &= R_i \gamma(p_{\lambda i}^{-1} g) \gamma(p_{\lambda i}^{-1}) \gamma(p_{\lambda i}^{-1}) \\ &= R_i \gamma(p_{\lambda i}^{-1}) \gamma(g) \\ &= \eta \gamma(g)\end{aligned}$$

Hence $\eta(gm) = \eta\gamma(g)(m) = \gamma_{i\lambda}(g)\eta(m) = g\eta(m)$ for all $g \in G$ and $m \in L$ and so the G -lattices L^0 and $L_{i\lambda}$ are isomorphic.

We illustrate the theorem in the following example.

Example 2. Consider S_3 and the lattice of its subgroups $L(S_3)$.

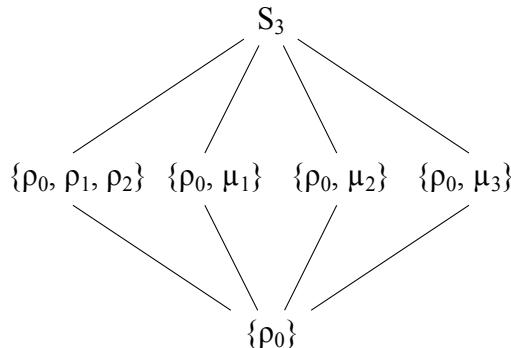


Figure 1. Lattice diagram of $L(S_3)$

It can be seen that $L(S_3)$ is a S_3 -lattice under conjugation. Then the corresponding representation $\gamma : S_3 \rightarrow \text{Aut}(L(S_3))$ is as follows.

◦	S_3	$\{ρ_0, ρ_1, ρ_2\}$	$\{ρ_0, μ_1\}$	$\{ρ_0, μ_2\}$	$\{ρ_0, μ_3\}$	$\{ρ_0\}$	$γ(ρ_0)$
S_3	$\{ρ_0, ρ_1, ρ_2\}$	$\{ρ_0, μ_1\}$	$\{ρ_0, μ_2\}$	$\{ρ_0, μ_3\}$	$\{ρ_0\}$	$γ(ρ_1)$	S_3
$\{ρ_0, ρ_1, ρ_2\}$	$\{ρ_0, μ_3\}$	$\{ρ_0, μ_1\}$	$\{ρ_0, μ_2\}$	$\{ρ_0\}$	$γ(ρ_2)$	S_3	$\{ρ_0, ρ_1, ρ_2\}$
$\{ρ_0, ρ_2, ρ_1\}$	$\{ρ_0, μ_2\}$	$\{ρ_0, μ_3\}$	$\{ρ_0, μ_1\}$	$\{ρ_0\}$	$γ(μ_1)$	S_3	$\{ρ_0, ρ_1, ρ_2\}$
$\{ρ_0, μ_1\}$	$\{ρ_0, μ_3\}$	$\{ρ_0, μ_2\}$	$\{ρ_0\}$	$γ(μ_2)$	S_3	$\{ρ_0, ρ_1, ρ_2\}$	$\{ρ_0, ρ_1, ρ_2\}$
$\{ρ_0, μ_3\}$	$\{ρ_0, μ_2\}$	$\{ρ_0, μ_1\}$	$\{ρ_0\}$	$γ(μ_3)$	S_3	$\{ρ_0, ρ_1, ρ_2\}$	$\{ρ_0, μ_2\}$
						$\{ρ_0, μ_1\}$	$\{ρ_0, μ_3\}$
							$\{ρ_0\}$

Let $S = \langle (S_3; 1, 2; P) \rangle$ where P is the 2×1 matrix, having both entries equal to $ρ_0$. Consider $R_1 : L(S_3) \rightarrow L(S_3)$ and $Q_1, Q_2 : L(S_3) \rightarrow L(S_3)$.

$$R_1 = \begin{matrix} S_3 & \{ρ_0, ρ_1, ρ_2\} & \{ρ_0, μ_1\} & \{ρ_0, μ_2\} & \{ρ_0, μ_3\} & \{ρ_0\} \\ S_3 & \{ρ_0, ρ_1, ρ_2\} & \{ρ_0, μ_2\} & \{ρ_0, μ_3\} & \{ρ_0, μ_1\} & \{ρ_0\} \end{matrix} !$$

$$Q_1 = Q_2 = \begin{matrix} S_3 & \{ρ_0, ρ_1, ρ_2\} & \{ρ_0, μ_1\} & \{ρ_0, μ_2\} & \{ρ_0, μ_3\} & \{ρ_0\} \\ S_3 & \{ρ_0, ρ_1, ρ_2\} & \{ρ_0, μ_3\} & \{ρ_0, μ_1\} & \{ρ_0, μ_2\} & \{ρ_0\} \end{matrix} !$$

Clearly $Q_1 R_1 = Q_2 R_1 = I_{L(S_3)} = \gamma(\rho_0)$.

Define $\Gamma : S \rightarrow \text{End}(L(S_3))$ such that $\Gamma(s) = R_i \gamma(g) Q_\mu$ for each $s = (g, i, \lambda) \in S$.

$$\Gamma(\rho_0, 1, 1) = R_1 \gamma(\rho_0) Q_1 = R_1 \gamma(\rho_0) Q_2 = \Gamma(\rho_0, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}} !$$

$$\Gamma(\rho_1, 1, 1) = R_1 \gamma(\rho_1) Q_1 = R_1 \gamma(\rho_1) Q_2 = \Gamma(\rho_1, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0 \}} !$$

$$\Gamma(\rho_2, 1, 1) = R_1 \gamma(\rho_2) Q_1 = R_1 \gamma(\rho_2) Q_2 = \Gamma(\rho_2, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0, \mu_1 \} \{ \rho_0 \}} !$$

$$\Gamma(\mu_1, 1, 1) = R_1 \gamma(\mu_1) Q_1 = R_1 \gamma(\mu_1) Q_2 = \Gamma(\mu_1, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0 \}} !$$

$$\Gamma(\mu_2, 1, 1) = R_1 \gamma(\mu_2) Q_1 = R_1 \gamma(\mu_2) Q_2 = \Gamma(\mu_2, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}} !$$

$$\Gamma(\mu_3, 1, 1) = R_1 \gamma(\mu_3) Q_1 = R_1 \gamma(\mu_3) Q_2 = \Gamma(\mu_3, 1, 2)$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_3 \} \{ \rho_0, \mu_2 \} \{ \rho_0 \}} !$$

It is easy to verify that Γ is a representation of S by lattice morphisms on $L(S_3)$. Consider $H_{11} = \{(g, 1, 1) | g \in S_3\}$ and $\gamma_{11} : G \rightarrow \text{Aut}(L(S_3))$ be the representation of G induced by the restriction of Γ into H_{11} . Then $\eta = R_1 \gamma(\rho_0) = R_1$ is a lattice isomorphism. Further it can be seen that η is a S_3 -lattice isomorphism. i.e., $\eta(gH) = g\eta(H)$ for all $g \in S_3$ and $H \in L(S_3)$. For consider,

$$\gamma_{11}(\rho_0)\eta = \Gamma(\rho_0, 1, 1)\eta$$

$$= \frac{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_1 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0 \}}{S_3 \{ \rho_0, \rho_1, \rho_2 \} \{ \rho_0, \mu_2 \} \{ \rho_0, \mu_3 \} \{ \rho_0, \mu_1 \} \{ \rho_0 \}} !$$

$$= \eta\gamma(\rho_0).$$

Similarly, $\gamma_{11}(g)\eta = \eta\gamma(g)$ for all $g \in S_3$ and so $\eta : L(S_3) \rightarrow L(S_3)$ is an isomorphism between the two S_3 -lattice structures on $L(S_3)$. So the theorem is verified for this case.

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¹ Research Scholar, Department of Mathematics, Cochin University of Science and Technology, Kochi, Kerala, INDIA

² Professor, Department of Mathematics, Cochin University of Science and Technology, Kochi, Kerala, INDIA.

Email address: alankathomas1@gmail.com, romeo_parackal@yahoo.com

The Impact of COVID-19 on Portfolio Allocation

Mathematical Optimization and Mixed Integer Linear
Programming

Yulin (Rain) Zhai*

Project Advisor: Prof. Benoît Legat †

Abstract

The impact of COVID-19 is ever-present in all aspects of our society. The global economy has undergone major changes through the shift in dynamics of power between respective sectors. February of 2020 marked the peak of the stock market before the outbreak triggered a free-fall in share prices. This paper will examine how the effects of COVID-19 have changed and shaped the allocation of funds in some of the leading stocks across their disparate sectors through both mathematical optimization models in mixed integer linear programming (MILP) and significant and critical events that might have contributed to the success or downfall of each distinct market. As well, quantitative and qualitative analysis is used to predict each stock's long-term performance.

Key words: Optimization; Portfolio Allocation; Investment Risk; Julia; JuMP

*St. George's School, rain.zhai2005@gmail.com

†Massachusetts Institute of Technology, blegat@mit.edu

1 Introduction

COVID-19 has unequivocally affected all aspects of our society, including the global economic landscape. February of 2020 marked the peak of the stock market before the outbreak triggered a free-fall in share prices. This paper will analyze how and why the funds allocated into each stock changed from May 2019 to May 2020, in comparison with May 2020 to May 2021 and predict each stock's long term performance.

Mathematical optimization models and decision making are not anything novel. They have always been the predominant focus of operations research, decision theory, management science, and economic theory. In 1952, Harry Markowitz, regarded as a pioneer for his theoretical contributions to financial economics and corporate finance, proposed his Nobel Prize winning works, espoused in his "*Portfolio Selection*" essay first published in *The Journal of Finance*, and later on more extensively in his book "*Portfolio Selection: Efficient Diversification*" in 1959. However, three major consequences quickly emerged: models were rather unstable because a minimal violation of a single constraint led to infeasibility; all considerations of uncertainty had to be cast into probabilistic models; and if more than one objective function was to be considered, the problem became complicated due to the several orders that were generated in the solution space. These limitations were inconvenient as they often reduced the degree of accuracy to which the model could adequately represent the real problem. Nonetheless, Markowitz's [1] groundbreaking work should not be easily overlooked as it formed the backbone of what is now known as the "Modern Portfolio Theory (MPT)."

Since Markowitz's contributions to MPT, the field of financial investing has undergone major evolutions, which include significant advances in financial concepts and the tools available to investors. In the present, while statistics-based mathematical modeling and formulas supporting MPT's theoretical assumptions are still significant, an emphasis is put on the development of a more simplified perspective of MPT's key theoretical assumptions [2], [3].

The fundamental purpose of Markowitz's [1] work is to demonstrate that under certain conditions, an investor's portfolio selection can be reduced to balancing only two critical dimensions: the expected return of the portfolio and the risk or variance of the portfolio. Therefore, this paper will investigate and analyze how COVID-19 has affected the portfolio allocation for five distinct stocks, each leading their disparate sector, through utilizing Markowitz's model of maximizing return and minimizing risk.

Through the use of Markowitz's [1] seminal work, we created a portfolio optimization model by using mixed integer linear programming (MILP) in Julia. This was to minimize the risk of the portfolio measured by the variability of the return, which is a quadratic function of the decision variables subject to linear constraints. Utilizing our model, we analyzed how the coronavirus has impacted our portfolio allocation on the five chosen stocks: Johnson & Johnson (JNJ), Amazon (AMZN), Simon Property Group (SPG), Boeing (BA), and JP Morgan (JPM). Each dominant stock chosen is a leader unique to its respective sector;

thus, we can assume the periodic trends are close to identical between each stock and its sector. Following this, we created two identical models with the same objective of minimizing the risk and optimizing our monthly return at a minimum of 5% or \$500. Utilizing both quantitative and qualitative data, a prediction is made for each stock's long term performance

2 Modelling

Suppose we invest \$10,000.00 for a one year period in five unique stocks, each within their respective sector: JNJ, AMZN, SPG, BA, and JPM. Note that we are not considering whether the stocks are dividend or non-dividend paying; as for our data collection, we used monthly adjusted closing price, which takes into account splits, dividend and/or capital gain distributions. Thus, for each of the two models, we will use the \$10,000.00 to buy shares of the five stocks at their current respective market prices. We will hold these for one year, and at the end of their respective year, we will sell the shares off at the prevailing market price. As a rational investor, we hope to make some profit out of this endeavor; in other words, the return on our investment should be positive. As the stock prices are quite uncertain and fluctuations in the market are imminent due to COVID-19, our model [1] effectively takes into account the trade-off between risk and return.

Let us adopt an indexing scheme on the set of stocks, where index i denotes a particular stock. The stocks JNJ, AMZN, SPG, BA, and JPM correspond to $i = 1, 2, 3, 4$, and 5, respectively.

Our decision variables are x_i , $i = 1, 2, 3, 4, 5$ denoting the amount of dollars invested in stock i . As we have a total of \$ 10,000.00 to invest, x_i 's must satisfy:

$$\sum_{i=1}^5 x_i \leq 10,000.00.$$

Let us make the following assumptions:

- (i) Short-selling is not allowed.
- (ii) Any continuum of shares can be traded.
- (iii) Transaction costs are negligible.

The above assumptions restrict the variables x_i to only hold non-negative real values.

$$x_i \geq 0 \text{ for } i = 1, 2, 3, 4, 5.$$

It is important to note that the end-of-month return of a stock i is uncertain; therefore, so is the return for our investment. Let us denote \tilde{r}_i as the random variable which corresponds to the monthly return; increase in stock price per dollar for stock i . The return/profit on x_i dollars invested in stock i is $\tilde{r}_i x_i$. Hence, the total return on our investment is $\sum_{i=1}^5 \tilde{r}_i x_i$.

The expected return on our investment is further modeled by $\mathbb{E} [\sum_{i=1}^5 \tilde{r}_i x_i] = \sum_{i=1}^5 \bar{r}_i x_i$, where \bar{r}_i is the expected value of \tilde{r}_i . Since we want to have an expected return of at least 5% or \$ 500.00, x_i 's has to satisfy:

$$\sum_{i=1}^5 \bar{r}_i x_i \geq 500.00.$$

To examine the notion of “risk” in our investment, we will utilize Markowitz's [1] work which shows that a rational investor's notion of minimizing risk can be closely approximated by minimizing the variance of the return of the investment portfolio. This variance is represented by:

$$\begin{aligned} \text{Var}[\sum_{i=1}^5 \tilde{r}_i x_i] &= \mathbb{E}[(\sum_{i=1}^5 \tilde{r}_i x_i - \sum_{i=1}^5 \bar{r}_i x_i)^2] \\ &= \mathbb{E}[(\sum_{i=1}^5 (\tilde{r}_i - \bar{r}_i) x_i)(\sum_{j=1}^5 (\tilde{r}_j - \bar{r}_j) x_j)] \\ &= \sum_{i=1}^5 \sum_{j=1}^5 x_i x_j \mathbb{E}[(\tilde{r}_i - \bar{r}_i)(\tilde{r}_j - \bar{r}_j)] \\ &= \sum_{i=1}^5 \sum_{j=1}^5 x_i x_j \sigma_{ij}, \end{aligned}$$

where σ_{ij} represents the covariance of the return of stock i with stock j .

There are two ways we can present the following optimization model for our problem:

$$\begin{aligned} \min \quad & \sum_{i=1}^5 \sum_{j=1}^5 x_i x_j \sigma_{ij} \\ \text{s.t.} \quad & \sum_{i=1}^5 x_i \leq 10,000.00, \\ & \sum_{i=1}^5 \bar{r}_i x_i \geq 500.00, \\ & x_i \geq 0 \quad i = 1, 2, 3, 4, 5. \end{aligned}$$

Note that even though we do not know the exact distribution of the random returns, we are able to obtain some statistical inference through analysis of historical data to estimate the value of \bar{r}_i and σ_{ij} . This will be further explored in the next section.

An alternative way we can represent the above optimization model is

$$\begin{aligned} \min \quad & x^T Q x \\ \text{s.t.} \quad & e^T x \leq 10,000.00, \\ & \bar{r}^T x \geq 500.00, \\ & x \geq 0. \end{aligned}$$

where x is the decision vector of size n (n is the number of stocks; $n = 5$), e is an n -vector of ones, \bar{r} is the n -vector of expected returns of the stocks, and Q is the $n \times n$ covariance matrix whose i - j th element $Q_{ij} = \sigma_{ij}$. Note that all equations and inequalities are defined component-wise.

3 Data Collection

As mentioned above, we need to determine the expected values as well as the covariances for the end-of-month returns of the five stocks. We will assume:

- (iv) The end-of-month stock prices have a stationary probability distribution.

Since the end-of-month returns on the stocks - defined as the ratio on the change in stock price to the last month's stock price - has a stationary distribution, we can estimate the expected values and covariances of the distribution through statistical analysis of historical data. Table 1 presents the adjusted closing prices of the five stocks on the last trading day of the month, from May 2019 to May 2020. Table 2 presents the adjusted closing prices of the five stocks on the last trading day of the month, from May 2020 to May 2021. Using the data from each table, the one-month return on the stocks can be calculated for both table 1 and table 2. The one-month return for the set of data in table 1 is shown in table 3. Likewise, the one-month return for the set of data in table 2 is shown in table 4. It is important to note that both table 3 and table 4 also show the average one-month return for each of the five stocks; this becomes an integral part of our calculations. The covariances among the returns of the five stocks are presented in table 5 and table 6, with the set of data from table 1 corresponding to table 5, and the set of data from table 2 corresponding to table 6. With numerical values from our calculations shown in the tables, we can now use these values for \bar{r}_i and σ_{ij} in our models.

Note that our analysis used above did not consider temporal effects as the resulting changes would be considered negligible [4]. Additionally, the expectation and covariances are estimated based on a small sample.

Month	JNJ	AMZN	SPG	BA	JPM
May-19	120.38	88.75	137.45	333.61	96.95
June-19	128.71	94.68	134.99	357.53	102.29
July-19	120.34	93.34	137.05	335.10	106.14
August-19	118.62	88.81	125.84	357.61	101.23
September-19	120.46	86.80	133.35	376.03	108.44
October-19	122.94	88.83	129.10	335.94	115.11
November-19	128.01	90.04	129.55	361.90	122.38
December-19	136.76	92.39	129.38	323.83	129.48
January-20	139.57	100.44	115.65	316.39	122.94
February-20	126.08	94.19	106.90	273.48	108.54
March-20	123.72	97.49	48.38	149.14	84.16
April-20	141.56	123.70	58.88	141.02	89.52
May-20	140.35	122.12	51.67	145.85	91.91

Table 1: Stock price data (\$) from May 2019 - May 2020

Month	JNJ	AMZN	SPG	BA	JPM
May-19	140.35	122.12	51.67	145.85	91.91
June-19	133.60	137.94	61.23	183.30	88.84
July-19	138.48	158.23	55.83	158.00	91.28
August-19	145.75	172.55	61.98	171.82	95.55
September-19	142.38	157.44	59.09	165.26	91.81
October-19	131.13	151.81	57.38	144.39	93.50
November-19	138.37	158.40	76.83	210.71	113.47
December-19	151.56	162.85	79.36	214.06	122.31
January-20	157.10	160.31	87.84	194.19	123.85
February-20	152.60	154.65	106.73	212.01	142.68
March-20	159.26	154.70	107.54	254.72	147.59
April-20	157.69	173.37	115.07	234.31	149.12
May-20	164.01	161.15	122.82	247.02	160.17

Table 2: Stock price data (\$) from May 2020 - May 2021

Month	JNJ	AMZN	SPG	BA	JPM
June-19	6.91	6.68	-1.79	7.17	5.51
July-19	-6.50	-1.42	1.53	-6.27	3.76
August-19	-1.43	-4.85	-8.18	6.72	-4.63
September-19	1.55	-2.26	5.97	5.15	7.12
October-19	2.06	2.34	-3.19	-10.67	6.15
November-19	4.12	1.36	0.35	7.73	6.32
December-19	6.84	2.61	-0.13	-10.52	5.80
January-20	2.05	8.71	-10.61	-2.30	-5.05
February-20	-9.67	-6.22	-7.57	-13.56	-11.71
March-20	-1.87	3.50	-54.74	-45.47	-22.36
April-20	14.42	26.88	21.70	-5.44	6.37
May-20	-0.85	-1.28	-12.25	3.43	2.67

Table 3: Stock Returns in percentages (\$ / \$) from May 2019 - May 2020

Month	JNJ	AMZN	SPG	BA	JPM
June-20	-4.81	12.95	18.50	23.68	-3.34
July-20	3.65	13.71	-8.82	-13.80	2.75
August-20	5.25	9.05	11.02	8.75	4.68
September-20	-2.31	-8.76	-4.66	-3.82	-3.91
October-20	-7.90	-3.58	-2.89	-12.63	1.84
November-20	5.52	4.34	33.90	45.93	21.36
December-20	9.53	2.81	3.29	1.59	7.79
January-21	3.66	-1.56	10.69	-9.28	1.26
February-21	-2.86	-3.53	21.51	9.18	15.20
March-21	4.36	0.03	0.76	20.15	3.44
April-21	-0.99	12.07	7.00	-8.01	1.04
May-21	4.01	-7.05	6.74	5.42	8.41

Table 4: Stock Returns in percentages (\$ / \$) from May 2020 - May 2021

	JNJ	AMZN	SPG	BA	JPM
JNJ	0.406	0.449	0.519	0.228	0.313
AMZN	0.449	0.757	0.522	-0.075	0.177
SPG	0.519	0.522	3.191	1.891	1.395
BA	0.228	-0.075	1.891	2.184	1.008
JPM	0.313	0.177	1.395	1.008	0.857

Table 5: The Covariance Matrix from May 2019 - May 2020

	JNJ	AMZN	SPG	BA	JPM
JNJ	0.260	0.052	0.047	0.189	0.143
AMZN	0.052	0.645	0.097	0.143	0.063
SPG	0.047	0.097	1.471	1.677	0.588
BA	0.189	0.143	1.677	3.167	0.717
JPM	0.143	-0.063	0.588	0.717	0.529

Table 6: The Covariance Matrix from May 2020 - May 2021

4 Solutions

We first minimized a quadratic objective function subject to linear constraints. Then by using mixed integer linear programming (MILP), we solved this optimization problem through using IPOPT in Julia [5] and obtained the following solutions:

- x_1 = Johnson & Johnson (JNJ)
- x_2 = Amazon (AMZN)
- x_3 = Simon Property Group (SPG)
- x_4 = Boeing (BA)
- x_5 = JP Morgan (JPM)

May 2019 - May 2020: $x_1 = 0.00$, $x_2 = 10,000.00$, $x_3 = 0.00$, $x_4 = 0.00$, $x_5 = 0.00$

May 2020 - May 2021: $x_1 = 0.00$, $x_2 = 2185.94$, $x_3 = 2233.91$, $x_4 = 0.00$, $x_5 = 4950.15$

where the value of x_i is the amount of money that should be allocated into stock i in order to achieve our goal of the safest way to have a monthly return of at least 5% or \$ 500.00.

5 Solution Analysis

Based on our solution, the optimal decision is to invest all \$ 10,000.00 into AMZN from the beginning of May 2019 - May 2020. However, from the beginning of May 2020 - May 2021, it can be seen that the optimal decision is to invest \$ 2815.94 into AMZN, \$ 2233.91 into SPG, and \$ 4950.15 into JPG.

For our first model (May 2019 - May 2020), suppose we made our investment on the last day of May 2020 with the resulting adjusted closing prices being:

$$JNJ := \$ 140.35, AMZN := \$ 122.12, SPG := \$ 51.67, BA := \$ 145.85, \text{ and } JPM := \$ 91.91$$

Thus, the optimal decision is to buy $(10,000/122.12 =) 81.887$ shares of AMZN. However, as shares can only be traded in whole numbers, the optimal decision would be to purchase 81 AMZN shares.

Similarly, for our second model (May 2020 - May 2021), suppose we made our investment on the last day of May 2021 with the resulting adjusted closing prices being:

$$JNJ := \$ 164.01, AMZN := \$ 161.15, SPG := \$ 122.82, BA := \$ 247.02, \text{ and } JPM := \$ 160.17$$

Thus, the optimal decision is to buy $(2815.94/161.15 =) 17.474$ shares of AMZN, $(2233.91/122.82 =) 18.188$ shares of SPG, and $(4950.15/160.17 =) 30.906$ shares of JPM. However, as shares can only be traded in whole numbers, the optimal decision would be to purchase either 17 or 18 shares of AMZN, 18 or 19 shares of SPG, and 30 or 31 shares of JPM.

On a further note, our results on how we should allocate our funds into each stock match with our Covariance Matrix. A Covariance Matrix, also known as a Dispersion Matrix and Variance-Covariance Matrix, is a measure of the correlation between how much two random variables change inter-dependent of each other; where a variance of 0 means the stock is constant, a low variance means the stock is relatively stable, and a high variance means the stock is very volatile. Since we want to minimize the risk of our investment, our model penalizes stocks with high variance and encourages stocks with low variance.

To understand how the coronavirus outbreak has affected our portfolio allocation, it is important to note that the stock market hit its peak in February of 2020, before the outbreak triggered a free fall in share prices. Detailed chronological description of each stock follows.

Johnson & Johnson (JNJ)

Johnson & Johnson (JNJ) — a holding company which engages in research, development, and manufacture/sale of products in the healthcare field — lost more than 23% (dropping from \$146 to below \$112) in share price from 2019 to 2020 [6]. Even though Johnson & Johnson quickly emerged as a front-runner in the birth stages of the COVID-19 vaccine, the vast commercial success of

similar vaccines developed by its rival companies, predominantly Moderna and Pfizer, quickly evened the playing field. Additionally, there were manufacturing delays that severely hindered Johnson & Johnson's distribution efforts. During the course of 2020 to 2021, the company saw a 1.7% decline in total shares outstanding due to share repurchases. This can be attributed to a few reasons, but primarily it was the result of Johnson & Johnson's medical devices revenues, which were down 12% in 2020 due to a 34% dip in sales. Medical devices account for nearly two-thirds of Johnson & Johnson's products, which are used in elective procedures [6]. With the enforced restriction placed across the globe early in the pandemic, many surgeries had to be deferred to a later time. This met with the temporary closure of many hospitals and the postponement of many surgeries. In addition, the company vowed to keep the COVID-19 vaccine a not-for-profit product, at least for the duration of the pandemic. Moreover, U.S. regulators recommended a pause in Johnson & Johnson's single-dose vaccine, as there were investigative reports of dangerous blood clots. This statement alone dropped Johnson & Johnson a further 1.3%. In contrast, Moderna rose by 7.4% [7]. The above reasons explain the extreme volatile nature of Johnson & Johnson during COVID-19. Hence, we should not allocate any funds into Johnson & Johnson both from 2019 - 2020 and 2020 - 2021.

Amazon (AMZN)

Amazon's (AMZN) — a vast Internet-based enterprise — stock price rose by 25% from the beginning to end of 2020 [8]. With the rapid global spread of coronavirus which led to lock-downs and reinforced measures in many cities around the globe, the industrial and economic activities have been completely torn apart. In contrast, Amazon has benefited greatly as million of people in the U.S. and abroad turned to online marketplace to fulfill their essential needs such as groceries, food, toiletries, and medicines. Due to the unexpected exponential rise in demand, Amazon has hired more than 100,000.00 additional warehouse and delivery workers. With the 63.3% increase of Amazon's stock, analysts at the investment firms Jefferies and Goldman-GS raised their estimates of Amazon price targets to \$3,800.00 per share, which is the highest estimate on the Street. Both firms emphasized Amazon's booming e-commerce business and indicated that Amazon's e-commerce segment grew by 93% year-over-year in May. Monness Crespi's analyst Brain White also stated in an interview that "during this crisis, Amazon has proven irreplaceable in delivering the daily necessities to people around the world, a fact that we believe will increase the number of customers on the platform, expand the list of products purchased by existing customers, accelerate the shift to e-commerce at large, and enhance the company's brand." Moreover, the day after the World Health Organization (WHO) declared COVID-19 as a global health emergency, Amazon's stock went up by about 16%, while the S&P 500 index saw a decline of about 15.2%. Additionally, around 60% of Amazon's total revenue comes from within the U.S., which has been the worst impacted by the outbreak [8]. Thus, no company's stock market value has benefited more from the coronavirus pandemic than

Amazon's. Hence, we should allocate funds into Amazon both from 2019 - 2020 and 2020 - 2021.

Simon Property Group (SPG)

Simon Property Group's (SPG) — the largest owner of shopping malls in the U.S. — shares went down about 5% in extended trading in the latter third of 2019, with total revenue also falling by 25% to \$1.06 billion from \$1.42 billion a year prior. The stocks fell another 47% in the first third of 2020 [9]. This was a direct result of the closure of all its malls and retail properties because of the coronavirus outbreak. The company decided on the nationwide closure of all properties after the closings of several department stores from Macy's, J.C. Penney, Nordstrom, and many other mall brands: Gap, Victoria's Secret, and Sephora. Furthermore, Simon Property Group furloughed about 30% of its workforce, which impacted both full and part-time workers in headquarters and at its malls and outlet centers across the US. Moreover, CEO David Simon did not receive a salary during the pandemic, and also the salaries of upper-level managements at the real estate company were cut by approximately 30% [10]. Additionally, many rents and payments from tenants are unpaid due to the economic downfall caused by COVID-19; even though mall owners also have their obligations of paying their utility bills and mortgage payments. However, with the lifting of restrictions, Simon is quickly recovering from its detrimental fall-back, collecting 85% of its billed rents from the third quarter of 2020, compared with 72% of billed rents collected during the second quarter. Statistics also show a continuous monthly improvement of traffic by customers from October 2020. Moreover, Simon Property's net income for the latter half of 2020 clocked in at \$1.062 billion, \$691.80 million up on a year ago [11]. Hence, we should not allocate funds into Simon Property Group from 2019 - 2020, but we should allocate funds into Simon Property Group from 2020 - 2021.

Boeing (BA)

Boeing's (BA) — a leading global aerospace company — sales fell nearly 26% to \$28.70 billion in the first half of 2020 [12]. As a result, the \$11.9 billion dollar net loss is the largest in the aerospace giant's more than 100-year history in part due to the coronavirus pandemic [13]. As airports shut down and international travel came to a halt due to fears of spreading the virus, people all across the globe were strongly encouraged to stay in their own homes and only leave when absolutely necessary. Therefore, air travel demand plummeted - over 60% since pre-pandemic [13]. The company forecasts that coronavirus will leave a detrimental imprint on the commercial aviation business, presenting a 10-year market outlook that is 7% lower than before the pandemic. One study estimates a 49% decrease in world passenger traffic evolution compared from 2021 to 2019, an overall reduction of 40% of seats offered by airlines from 2020 to 2021, and an approximate loss of \$324 billion USD of gross passenger operating revenues

from 2020 to 2021 [13]. Hence, we should not allocate any funds into Boeing both from 2019 - 2020 and 2020 - 2021.

J.P. Morgan (JPM)

J.P. Morgan's (JPM) — a leading global financial services firm — earning results in 2019 was atrocious. This was mainly due to a \$6.8 billion addition to loan loss provisions [14]. However, with the gradual increase of global financial stability: consumer banking deposits grew by approximately 10%; client investment assets grew by approximately 3%; credit card sales volume grew by approximately 4%; and the bank's book value grew by approximately 6% in the latter half of 2020 [14]. J.P. Morgan, together with the rest of the big banks, is well-capitalized and can recover relatively quickly through a recession, regardless of its time-frame. For instance, deposits grew in every line of the bank's business during the first quarter of 2020, and the bank was also very active in both consumer and business lending, while most of the economy was shut down [15]. Hence, we should not allocate funds into J.P. Morgan from 2019 - 2020, but we should allocate funds into J.P. Morgan from 2020 - 2021.

6 Conclusion

Our rapidly changing global economy is truly unpredictable. With many developed countries on the verge of bursting their economic bubble [16], the addition of COVID-19 is a recipe for disaster. While inflation has soared higher than ever before, the stock market has reached an all-time low. That being said, the future looks a bit more promising as the effect of coronavirus gradually subsides and many restrictions are loosened. We will combine our quantitative data collected from our model with qualitative data analyzed from significant events to examine and predict each stock's long term performance.

For Johnson & Johnson, the company plans to fully recover by the end of 2022. Vaccine sales for COVID-19, accounted for less than 3% of the company's top line [17]. Furthermore, with lockdown restrictions being lifted in many cities around the world, healthcare institutions have begun elective surgeries. This means, hopefully, a gradual increase in hospital visits, surgeries performed, and number of prescriptions for medications issued. Even with the volatile situation throughout the pandemic, Johnson & Johnson's stock owners can be re-assured since both the consumer health and the pharmaceutical segments continue to recover. The company will carry on producing many of its mainline products, such as Tylenol, that are integral to the treatment of severe diseases like immunology, oncology, neuroscience, and infectious diseases, and/or daily medications [18].

For Amazon, the future - post-coronavirus - remains uncertain. Amazon's stock is likely to under-perform as was the case with Walmart back in the SARS outbreak. The surge in exponential demand during the early stages of COVID-19 is likely to subside as citizens are expected to go back to shop from brick and

mortar. Studies have shown that the majority of people still enjoy shopping in-person more than shopping online, as for many, it is not about whether they buy the physical product, but the “experience” that they desire. Nonetheless, Amazon’s stock will remain stable, even though it is likely to under-perform compared with how it did during COVID-19.

For Simon Property Group, the company plans to fully recover by the end of 2023. With the rollout of COVID-19 vaccines, easing restrictions, and new rounds of government stimulus boosting mall traffic, Simon Property Group has been able to rebound from a coronavirus-driven downturn in 2020 when many of its tenants went out of business or cut back on rent payments. Simon Property Group has once again re-opened all its malls that had been previously shutdown due to the fear of spreading the virus [19]. As long as the malls stay open, Simon Property Group’s performance is likely to remain stable, since people still enjoy shopping in old-fashioned brick-and-mortar stores.

For Boeing, the company plans to fully recover to pre-pandemic levels by late 2023 or early 2024. According to Darren Hulst, Boeing’s vice-president of commercial marketing, “despite the pandemic, aviation industry would revert to long-term [market] trends of 4 to 5 % annual growth by mid-decade, knocking only a couple thousand aircraft from Boeing’s 20-year forecast of 43,610 deliveries.” The company also took into consideration the global economic growth which expands at a rate of 2.7 % annually, and passenger and cargo traffic which increases by approximately 4% annually [20]. It is also important to note that even though there were fewer passenger flights in 2021 due to international lockdowns, more goods/supplies were shipped by air than ever. Boeing expects the number of freighters worldwide to grow from 2,010 to 3,435 by 2040 [21]. Furthermore, the company forecasts the aerospace and defence market will have a value of \$9 trillion over the next 10 years, with \$3.2 trillion from commercial planes, \$3.2 trillion from services, and \$2.6 trillion from defence [20]. For as long as we need transportation, Boeing’s excellent performance will likely continue in the long-run.

For JP Morgan, the company plans to fully recover by the end of 2022. The bank estimates the U.S. S&P 500 (SPX) will rise nearly 8%, emerging market stocks to surge 18%, and 10-year U.S. Treasury yields - a key driver of global borrowing costs - to rise to 2.25% by the end of 2022 [22]. JP Morgan and many other banks are well-capitalized, thus, even if there is a recession, they should recover relatively quickly [15]. JP Morgan’s performance is likely to stay stable and consistent with its growth.

The possibility of applying our optimization model to major events in the past, present (i.e. Ukraine War, COVID-19, etc.), and future is achievable; however, to apply our model more accurately, a larger data collection, more constraints, and more variables are required. Additionally, the analysis process would involve much more sophisticated statistical and time series models in order to obtain reliable estimates of the means and covariances.

Supplemental Material

Supplemental material to this paper is available at <https://github.com/RainZhai05/Portfolio-Optimization/blob/2eee1c14254d1c63537fe8c225cfb30e2e6759c6/Portfolio%20Optimization.ipynb>.

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Integral Domains and Alexandroff Topology

Shai Sarussi

Abstract— Let S be an integral domain which is not a field, let F be its field of fractions, and let A be an F -algebra. An S -subalgebra R of A is called S -nice if $R \cap F = S$ and $FR = A$. A topological space whose set of open sets is closed under arbitrary intersections is called an Alexandroff space. Inspired by the well-known Zariski-Riemann space and the Zariski topology on the set of prime ideals of a commutative ring, we define a topology on the set of all S -nice subalgebras of A . Consequently, we get an interplay between Algebra and topology, that gives us a better understanding of the S -nice subalgebras of A . It is shown that every irreducible subset of S -nice subalgebras of A has a supremum; and a characterization of the irreducible components is given, in terms of maximal S -nice subalgebras of A .

Keywords— Alexandroff topology, integral domains, Zariski-Riemann space, S -nice subalgebras.

Artificial Intelligence Technologies Used in Healthcare: A Study of its Implications on the Healthcare Workforce and Applications in the Diagnosis of Diseases

Dr. Rowanda D. Ahmed¹, Dr. Mansoor Abdulhak², Muhammad Azeem Afzal³, Sezer Filiz⁴, Usama Ahmad Mughal⁵

MS Cyber Security, Uskudar University, Istanbul, Turkey^{1,3,4,5}

Abstract: This paper discusses important aspects of AI in the healthcare domain. The increase of data in healthcare both in size and complexity, opens more room for artificial intelligence applications. Our focus is to review the main AI methods within the scope of the healthcare domain. The results of the review show that recommendations for diagnosis and recommendations for treatment, patient engagement, and administrative tasks are the key applications of AI in healthcare. Understanding the potential of AI methods in the domain of healthcare would benefit healthcare practitioners and will improve patient outcomes.

Keywords: AI in healthcare, technologies of AI, neural network, future of AI in healthcare

1 Introduction

Artificial intelligence (AI) applications have become widely available in business and society. Healthcare is a new application area for AI. Applications of AI technologies have great potential for all parties of healthcare systems, service providers, insurance companies, and pharmaceutical industries. The patient care approach will change with the applications of AI. AI can perform better than humans in the diagnosis of diseases. As more data builds up in the radiology database the performance of AI will increase in the diagnosis of diseases. It is believed that AI applications in the diagnosis of disease will not replace humans.

Artificial intelligence is the sum of several technologies. AI technologies have wide applications in the area of healthcare. Some of the AI technologies which are mostly used are stated below. The most common one is machine learning which has training functionality with data. Machine learning has two subsets: One of them is deep learning and the other one is neural network. Precision medicine is an application of conventional machine learning in healthcare. Precision medicine could be defined as predicting which treatment protocols are likely to be successful according to attributes of the patient treatment protocol [1]. Supervised learning is used in precision medicine: A dataset recorded for a specific disease is used to train the precision medicine applications. The same is true for most of the machine learning applications. Neural networks are used in healthcare for almost 30 years. It is used in research and in diagnosing several diseases [2]. Deep learning models have a set of variables that help the system to predict the outcomes. The enhancements in graphics processing have led to faster systems available for the recognition of lesions that are cancerous in radiology images [3]. As the accuracy of diagnosis increases, image analysis is mainly used in oncology clinics. Computer-aided detection (CAD) is used for such diagnosis.

2 Literature Review

Nowadays, artificial intelligence (AI) become an integral part of healthcare thanks to recent advances in machine learning models, computer science, and Deep learning. these new models help in searching and uncovering insights from the huge numbers of medical data records and end up with improved health outcomes in a short time compared to the time it takes a human to find less accurate results.

Many significant AI breakthroughs in the healthcare sector made using AI in healthcare tending nowadays. Moreover, knowledge collection on that side plays a significant role in enhancing many AI-based healthcare projects. In addition, there are several proposed techniques in their way to enhance and facilitate getting medical services especially in remote places.

Worldwide, the aging population is constantly growing. And there are many challenges are accompanied by that growing [4]. So, the need for healthcare robots to cover the shortage of caregivers and healthcare workers all in homes [5,6], rehabilitation centers, healthcare centers, workplaces [7,8], and schools [9], became badly needed [10].

Moreover, robots don't complain about decreasing energy, lack of motivation, feelings of frustration, burnout, or emotional exhaustion, which can lead to a decrease in work efficacy and productivity. So, adopting robots in healthcare leads to safe and high-quality healthcare [11].

3 AI technologies in healthcare

3.1 Deep Learning

Radiology images are mainly used for diagnosing cancerous lesions. Deep learning has great potential in recognition of such lesions. Using deep learning lessons which could not be seen by human eye are detected. Deep learning has applications in three different areas of healthcare; patient care (medical imaging, healthcare data analytics, mental health chatbots, personalized medical treatment, prescription audit, responding to patient queries), health insurance (underwriting, fraud detection), research and development (drug discovery, genomics analysis, mental health research, COVID-19).

3.2 Natural language processing

AI researchers are working on human natural languages' Processing, NLP, for a long time. Some examples of these projects are text to speech, speech to text, translation of speech and text, summarization, image captioning are all depend on processing, understanding and generation of natural languages, NLP, NLU, and NLG. Neural network, a part of machine language is mainly used in the recognition of voice. Clinical documentation is analyzed, classified, and reported by NLP systems.

Applications of NLP in healthcare will increase as the data capacity of the healthcare industry increases. Care quality can be measured and care quality can be improved. Physicians can use large data available with NLP algorithms to make right decisions in complex cases.

3.3 Physical robots

Physical robots perform uncountable jobs, like lifting, repositioning in logistics, welding, delivery, and assembling operations in the manufacturing industry. And the increase in robots reduces the workers' exposure to physically intensive work, especially in the healthcare sector since surgeons can make operations with minimal incisions precisely [12].

Robots are evolving constantly over time with AI new technologies, so they surprised us every single day with new different capabilities.

4 Discussion

As noted earlier, traditional and manual methods were used for both diagnosing and feature extraction, which was considered difficult and time-consuming [13, 14].

The existence of data and information is the most important element for deep learning algorithms. Recently, several research uses electronic health data records to develop new predictable models to predict and diagnose diseases and then evaluate the results. Doing that manually, due to limited automated systems, leads to degraded accuracy results.

And as we know about the input data records, garbage input leads to garbage output for sure. So, it all depends on the quality of the input data. So if the electronic health data records are irrelative, the diagnosing results out of the models will be far from being precise which in turn leads to incorrect prediction as well. Authors in [15, 16] try to propose solutions for this challenge, which depend on Deep Learning. The model is constructed from a multilayer Conventional Neural Network (CNN) as shown in Fig 1. below. CNN is considered an effective deep learning model which is able to detect various diseases with both fast and precise results.

for instance, if the input of the CNN model is an image, CNN tries to discover the input image feature by expanding the pixels of the image through the neural network layers. In each layer, the neurons of that level get kind of features like lines then the next levels of layers get better and more complicated features until reaching the last output layer which tries to determine the specific pattern that the input image is related to like predicting the disease based on the some symptoms of that disease [17,18].

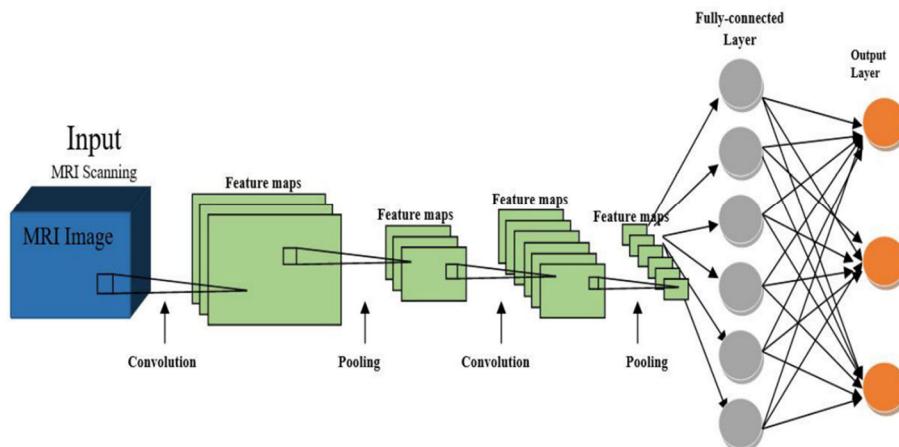


Fig. 1: Disease diagnosis using Deep Learning [19].

4.1 Administrative applications

Administrative transactions are very heavy and crucial in healthcare. Applications of AI reduce much of nurses' time in administrative tasks. It is found that 25% of US nurses' time is spent on such tasks. Repetitive activities are boring for healthcare staff and error-prone. With help of AI applications in the healthcare industry, doctors and nurses will have more time to focus on their actual work [20].

4.2 Implications for the healthcare workforce

Automation of workforce with robotic applications, in general, AI applications in healthcare rises attention for the job loss of the healthcare workforce. The jobs that deal directly with patients will not be affected. Radiology and pathology jobs will be automated but this will not replace humans as expected. The technology reads and interprets images, but radiologist not only do that rather communicates with other doctors during the diagnosis process [21].

There had been no jobs removed with the applications of artificial intelligence in healthcare to date, the hospital staff who are in direct contact with patients will not lose their jobs for sure. Ones that are more skilled if they cannot train themselves will replace the other staff.

4.3 Ethical implications

Accountability and usage of personal data are of great importance as ethical implications of AI. Humans made the decisions and hence human was accountable in the past. If an AI system makes a faulty decision, how accountability will be handled. AI decisions based on Image processing use extensive patient data. What will be the personal rights? Algorithmic problems may cause the wrong computer-aided detection results [22].

The ethical implications of applications of AI in healthcare should be studied by all parties, including healthcare providers and regulative bodies. Probably it will take several years to reach a common base.

4.4 Adherence applications

Medication adherence is of great importance in both standardized treatments and in the clinical trial of new drugs. Direct reporting of non-adherence issues from patients sometimes causes misleading outcomes due to subjective estimates. With help of applications of AI, data that are more accurate can be obtained from patients regarding their adherence to medication. Detect non-adherence situations can easily in advance as compared to classical methods. AI application in adherence will enable the physicians to follow up on the patient's situation and generate strategies for treatment.

5 Conclusion and the future of AI

AI will have more applications in the future of healthcare. As computing power and the recorded data increase capability of machine learning will increase. Regulatory issues should be resolved. AI accountability is still a question. Extensive clinical usage will take some time. After massive usage of AI, care for patients and human skills will be dominant for clinicians. AI can only replace a small amount of the healthcare workforce despite expected.

We assume that AI will in the end grasp that area. Improvements in image analysis will enable machine to test snapshots of radiology as AI applications in the future. Speech and textual content reputation are already hired for duties like affected person conversation and seize of scientific notes, and their utilization will increase.

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Latest Results from the CUORE Experiment

Cuore Coll

Abstract— The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for $0\nu\beta\beta$ decay that has been able to reach the one-tonne mass scale. The detector, located at the LNGS in Italy, consists of an array of 988 TeO₂ crystals arranged in a compact cylindrical structure of 19 towers. CUORE began its first physics data run in 2017 at a base temperature of about 10 mK and in April 2021 released its 3rd result of the search for $0\nu\beta\beta$, corresponding to a tonne-year of TeO₂ exposure. This is the largest amount of data ever acquired with a solid state detector and the most sensitive measurement of $0\nu\beta\beta$ decay in ¹³⁰Te ever conducted, with a median exclusion sensitivity of 2.8×10^{25} yr. We find no evidence of $0\nu\beta\beta$ decay and set a lower bound of 2.2×10^{25} yr at a 90% credibility interval on the ¹³⁰Te half-life for this process. In this talk, we present the current status of CUORE search for $0\nu\beta\beta$ with the updated statistics of one tonne-yr. We finally give an update of the CUORE background model and the measurement of the ¹³⁰Te $2\nu\beta\beta$ decay half-life, study performed using an exposure of 300.7 kg-yr.

Keywords— Bolometric detector, neutrinoless double beta decay, double beta decay, rare events..

Cuore is with the in University of Milano Bicocca, Italy (e-mail: cuore-speaker@mailman.yale.edu).

Challenges in the Assessment of the Relationships Between Urban Green Landscape Aesthetics and Biodiversity

Ksenia Zakharova

Abstract— The last 20 years of a new Millenia were characterized by the fast-growing interest in landscape quality assessment and a shift toward ecosystem management in the form of stakeholders' involvement in defining sustainable alternatives for the interactions of people and the environments ("Millennium ecosystem assessment", 2005). A focal question is how biodiversity is perceived by local stakeholders in the context of Inclusive ecosystem management practices. The main aim of the research is to reveal a knowledge gap in the studies, devoted to the analysis of relationships between biodiversity and aesthetic experience accepted by people. The objective is to map the scientific landscape of the literature discussing aesthetic values in the context of people-nature relations. The systematic search was conducted using a robust systematic method and focused on research published in the period from 2000 to 2021. Evidence was collated from Electronic Databases: Web of Science, Scopus. A total of 50 studies, that fulfilled the criteria of search, were selected for the analysis. The study revealed that in most papers the assessment of people-nature relationships is based on the analysis of three conceptual components of biodiversity in the urban green areas and three conceptual components of human aesthetic perception of that areas. Biodiversity is considered as compositional biodiversity, functional biodiversity, and structural biodiversity. Human eco-aesthetic perception is considered as the perception of biodiversity as a mental construct, the perception of visually distinguishable diversity (distinctive elements in the system), and the process of preference. Thirty-two articles studied the relationship between only one of the three conceptual components of biodiversity and only one of the three conceptual components of human landscape aesthetics perception. Twelve articles studied the relationship between two components of biodiversity and two of the three conceptual components of human landscape aesthetics perception couples. In six articles, more than three pairs of such relationships were studied. Moreover, all authors suggest a concept substitution, namely a theoretical transfer from the established structure of the relationships between the certain aspects of eco-diversity of the city landscapes and sense perception of those landscapes to concepts as indivisible entities. However, the authors do not provide theoretical grounds for such a transition from a particular result interpretation to a general conclusion. This leads to a logical contradiction in generalizations about the connection between studied phenomena. Namely, different researchers establish different characteristics of existing connections: the strength and direction of the relationships between biodiversity and its aesthetic perception by humans are different. This speaks of a gap in current knowledge in the area of study. In addition, it was identified that contrasting conclusions are often obtained within the same study. The situation may be positioned as follows: researchers are trying to divide the concepts into distinctive parts for the convenience of further analysis, however, they do not provide a specification of the reverse synthesis procedure, since we do not have a theoretical basis that may provide the procedure of synthesizing the different aspects of the problem. Summing up, the main challenge in the field of eco-aesthetics in studying the relationship between urban ecosystem biodiversity and human

aesthetic preferences should be recognized as the lack of a holistic theory of human aesthetic perception of biodiversity.

Keywords— urban green landscape, ecoaesthetics, human aesthetic perception, biodiversity.

Ksenia Zakharova is with the in Södertörn University, Sweden (e-mail: ksenia.zakharova@sh.se).

Changes in Pain Intensity of Musculoskeletal Disorders in Flight Attendants After Stretching Exercise Program

Maria Melania Muda, Retno Wibawanti, Retno Asti Werdhani

Abstract—Background: Flight attendant (FA) is a job that is often exposed to ergonomic stressors; thus, they are very susceptible to symptoms of musculoskeletal disorders (MSDs). One of the ways to overcome musculoskeletal complaints is by stretching. This study aimed to examine the prevalence of MSDs and the effect of a 2-week stretching exercise program using the Indonesian Ministry of Health's stretching video on changes in musculoskeletal pain intensity in FA on commercial aircraft in Indonesia. Methods: A pre-post study was conducted using Nordic Musculoskeletal Questionnaire (NMQ) for MSDs' identification and Visual Analog Scale (VAS) as pain intensity measurement. Data was collected and then analyze using SPSS with Wilcoxon test. The change in pain intensity was considered significant if the P value < 0.05. Results: The results showed that 92% of the FA (n=75) had MSDs in at least 1 area of the body in the last 12 months. Thirty-four respondents were participated as subjects. The complaint level score in 28 body areas before intervention was a median of 34 (29-84), with pain intensity of a median of 6 (2-9) became a median of 32 (28-67) and a median of 3 (0-9) after the intervention, respectively, with p value <0.001. Conclusion: The stretching exercise program showed significant changes in the complaint level scores in 28 body areas ($p<0.001$) and pain intensity before and after the stretching exercise intervention ($p<0.001$).

Keywords—Flight attendant, MSDs, Nordic Musculoskeletal Questionnaire, stretching exercise program, Visual Analog Scale.

I. INTRODUCTION

MUSCULOSKELETAL disorders (MSDs) are a pain in the muscles, tendons, and nerves arising from repetitive, continuous, and unnatural movements. These symptoms can be experienced in various body areas and affect the quality of life by interfering with daily work activities [1]. Work-related MSDs are conditions in which the work environment and performance significantly contribute to symptoms of MSDs or get worse or last longer due to work conditions [2].

M. M. Muda is with Aviation Medicine Specialist Program, Faculty of Medicine, Universitas Indonesia, Jakarta, 10430, Indonesia (email: maria.melania@ui.ac.id)

R. Wibawanti is with Aviation Medicine Specialist Program and Department of Community Medicine, Faculty of Medicine, Universitas Indonesia, Jakarta, 10430, Indonesia (email: retronwibawanti1980@gmail.com).

R. A. Werdhani is with Department of Community Medicine, Faculty of Medicine, Universitas Indonesia, Jakarta, 10430, Indonesia (email: retnoasti@yahoo.com)

The World Health Organization (WHO) in 2021 reported that around 1.71 billion people worldwide had musculoskeletal

complaints with low back, with the highest prevalence of 568 million people [3]. The risk factors for MSDs are divided into three, namely; biomechanical, individual, and psychosocial factors. Biomechanical factors include awkward and static body postures for a long time at work, heavy loads, repetitive movements, exposure to vibration, and a long duration of exposure. Individual factors are related to age 30 years and over, female gender, excess body mass index, smoking habit, low level of physical fitness, and long working period. Psychosocial factors are interactions between the work environment, work, organizational conditions, capacity and fulfillment of workers, culture, and personal considerations with excessive work [4].

Flight Attendant (FA) is one of the jobs often exposed to ergonomic stressors, including those related to manual material handlings, such as dealing with heavy trains and objects and working posture (standing for too long and often bending over). Thus, they are prone to symptoms of MSDs [5]. According to a study of FA conducted by Morley-Kirk in 2003, the proportion of individuals with MSDs reached 87% of 674 subjects [6]. In Lee Hyeonkyeong's study, it was reported that 97% of 185 flight attendants had experienced MSDs in the past year [7]. Revati et al. reported that 82% of 33 flight attendants experienced MSDs in one or more body regions. In addition, FA works in a narrow and confined area, giving them less freedom to move and less opportunity to alternate extremities. Lack of flexibility in choosing body positions, in turn, leads to fatigue and pain. Pain in the neck and shoulders can occur due to repetitive overhead activities such as closing the luggage compartment and pushing and pulling heavy trolleys [8].

One way to overcome musculoskeletal complaints is to stretch the muscles. Stretching is a form of physical activity in which certain skeletal muscle mass is deliberately extended to its maximum length to increase muscle flexibility. The benefits of stretching include increased flexibility, range of motion in joints, circulation, posture, and as a stress reliever. Stretching before or after physical activity can reduce the likelihood of strains or sprains by increasing the flexibility of muscles, tendons, and ligaments thus increasing the mobility of one or more joints [9]. Stretching is done before and after physical activity. It can also be done in the morning before starting the activity, at the office to release tension, after sitting or standing for a long time, when the body feels stiff, or at certain times of the day such as watching television, reading, and so on [10].

Several studies have shown that stretching exercises reduce discomfort/pain and increase range of motion [9]. Ronny (2016)

reported a significant effect of giving muscle stretching to musculoskeletal complaints and saturation in workers in the sewing section of the garment division of a textile company [11]. Chika Tania in 2020 reported an effect of stretching exercises on complaints of MSDs in administrative employees at Lampung Food and Drug Supervisory Agency [12]. However, we need study on the impact of stretching on MSD in the population of flight attendants who have MSD risk factors during their work.

Based on this background, this study aims to examine the prevalence of MSDs and the effect of a stretching exercise program using stretching videos from the Ministry of Health of the Republic of Indonesia on changes in musculoskeletal pain intensity in flight attendants on commercial aircraft in Indonesia.

II. RESEARCH METHOD

This research is a pre-post study and uses the Nordic Musculoskeletal Questionnaire, Visual Analog Scale, and intervention with stretching exercises according to a video from the Ministry of Health of the Republic of Indonesia. The sampling method is the convenience sampling method. Inclusion criteria were flight attendants willing to participate in the study, were on active duty in the last year, and had MSDs (marked by NMQ score ≥ 29 ; VAS score ≥ 1). Exclusion criteria were flight attendants who did not fill out the questionnaire completely. Drop-out criteria were subjects who did not follow stretching for one day (subjects had to follow stretching exercises for 14 days) or experienced an injury during the data collection process that affected the study's outcome.

FA were asked to fill in the identity and the Nordic Musculoskeletal Questionnaire to assess the presence of MSDs and assess which areas felt the most pain through Google Form. The area of the body that feels most painful is assessed for pain intensity using the Visual Analog Scale. FA asked to participate in stretching exercises were those with MSDs (marked by pain intensity on NMQ ≥ 29 ; VAS score ≥ 1). Subjects willing to participate in stretching exercises will be given a briefing on the stretching exercise program and will follow stretching exercises for 14 days.

Due to the COVID-19 pandemic, the stretching exercise was carried out through a Zoom meeting led by the researcher. The stretching exercise video has 2 minutes 41 seconds and consists of five sets of movements in the neck, shoulders, arms, hands, back, waist, upper and lower legs, and feet. The exercise will begin with warming up for ± 1 minute and cooling down for ± 1 minute later. The stretching time via Zoom Meeting is at 08.00 a.m., 10.00 a.m., 12.00 p.m., 02.00 p.m., and 05.00 p.m. Subjects can choose one of the Zoom meeting times to be

followed on that day. Together with the researcher, subjects followed all the stretching movements from the video. Stretching was done for 16 days (14 main days and two extra days). Two extra days were reserved for subjects unable to attend on one/two days during the main 14-day stretch. After 14 days of stretching exercises, subjects were asked to fill out a questionnaire in the form of a Google Form, namely the Nordic Musculoskeletal Questionnaire to assess the presence of MSDs and the Visual Analog Scale to assess the intensity of the pain felt.

Filling out the online questionnaire starts on July 22, 2021, until August 31, 2021. There are 83 questionnaires filled out and 75 questionnaires that meet the requirements. These 75 respondents were used as prevalence data. A total of 40 people met the inclusion criteria and were willing to participate in the stretching exercise intervention. The stretching exercise was carried out for two periods, and each participant only participated in one period. The first period started from July 27, 2021, to August 12, 2021, and the second period started from August 3, 2021 - to August 17, 2021. Period I was attended by 32 participants, and period II was attended by eight participants. There were six drop-out participants at the end of the period, so the final number of all research subjects with the intervention was 34 people.

SPSS version 26.0 was used for statistical analysis. The data is presented in descriptive and analytic forms. Differences in NMQ scores before and after intervention and differences in pain scale based on VAS before and after intervention were analyzed by Wilcoxon test.

This research has received approval and has passed the ethical clearance from the Health Research Ethics Committee, Faculty of Medicine, University of Indonesia, number KET-682/UN2.F1/ETIK/PPM.00.02/2021.

III. RESULTS

The characteristics of all respondents who filled out the questionnaire based on age, job characteristics, MSDs, and pain intensity according to VAS can be seen in Table 1. Of 75 respondents, 53 respondents (70.7%) were aged 18 – 39 years, with a mean age of 36 years, 29 (SD: 9.68). A total of 46 respondents (61.3%) have worked for 10 years or more, and 84% of respondents have total flight hours per month of fewer than 75 hours, with an average number of flying hours per month of 47.99 hours (SD: 18.85). A total of 69 respondents (92%) experienced MSDs with symptoms of aches, pain, or discomfort in at least 1 area of the body in the last 12 months with a low level of complaints.

TABLE I
CHARACTERISTICS OF RESPONDENTS FILLING OUT THE QUESTIONNAIRE (n = 75)

Variable	n	%
Age		
18 - 39	53	70.7
40 - 59	22	29.3
≥ 60	0	0
Years of Employment		
1 - 5	7	9.3
6 - 9	22	29.3
≥ 10	46	61.3
Total Flight Hours per Month		
< 75	63	84
≥ 75	12	16
MSDs		
Yes	69	92
No	6	8
Level of Complaints of MSDs		
Low	62	89.86
Moderate - Very High	7	10.14
Nilai VAS		
1		
2	1	1.4
3	2	2.9
4	8	11.6
5	16	23.2
6	9	13
7	3	4.3
8	9	13
9	17	24.6
10	3	4.3
	1	1.4

Fig. 1 describes the area of the body that most respondents complain about. A total of 43 respondents (57.3%) complained of pain in the waist, followed by the right shoulder (54.67%), back (50.67%), left shoulder (46.67%), and lower neck (42.67%).

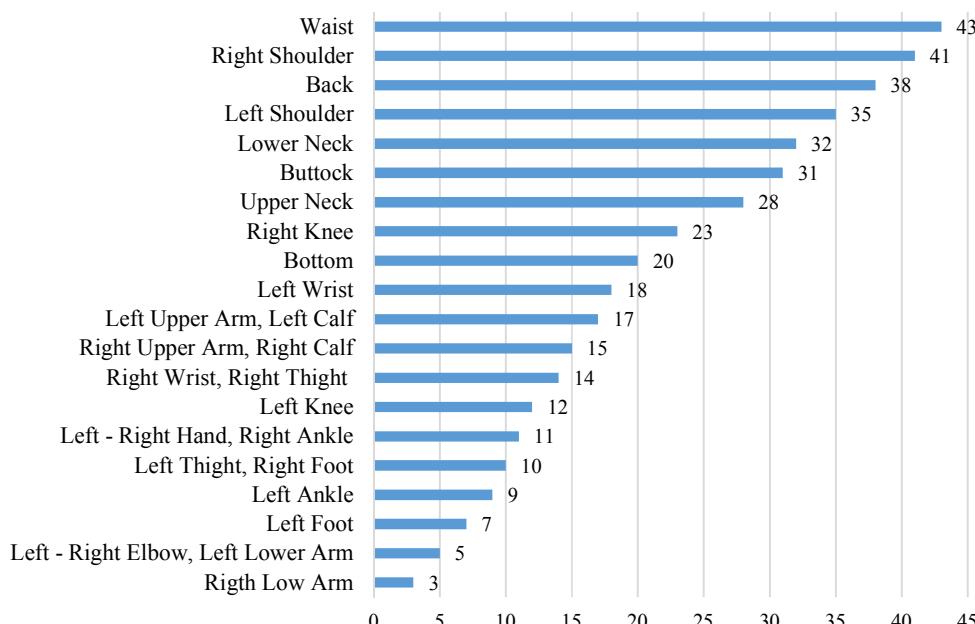


Fig. 1 Distribution of Complaint Locations for Musculoskeletal Disorders

Most respondents complained of the highest pain intensity in the shoulder area (33.4%), followed by the waist area (14.7%), back (10.7%), buttock (6.7%), and right knee (5.3%). The average pain intensity felt by respondents in the most painful area based on the VAS value was 5.23 (SD: 2.58).

TABLE II
CHARACTERISTICS OF RESEARCH SUBJECTS WHO PARTICIPATED IN
STRETCHING EXERCISE PROGRAM (n = 35)

Variable	n	%
Age		
18 - 39	25	73.5
40 - 59	9	26.4
≥ 60	0	0
Years of Employment		
1 - 5	6	17.6
6 - 9	13	38.2
≥ 10	15	44.1
Total Flight Hours per Month	29	85.3
< 75	5	14.7
≥ 75		
Level of Complaints of MSDs	30	88.2
Low	4	11.7
Moderate - Very High	0	0
Nilai VAS		
1	5	14.7
2	6	17.6
3	4	11.8
4	2	5.9
5	6	17.6
6	9	26.5
7	1	2.9
8	0	0
9		
10		

TABLE III
CHANGES IN COMPLAINT LEVEL SCORES IN 28 BODY AREAS AND PAIN INTENSITY IN THE MOST PAINFUL BODY AREAS POST INTERVENTION

	Before Intervention	After Intervention	Median Difference (Delta)	p Value
Complaint Rate Scores in 28 Body Areas	34 (29 - 84)	32 (28 - 67)	3 (-3 - 28)	< 0.001 ^w
Pain Intensity in the Most Painful Areas of the Body	6 (2 - 9)	3 (0 - 9)	2 (0 - 7)	< 0.001 ^w

^w)Wilcoxon test

Data analysis showed a change in the complaint level score in 28 body areas compared to before the intervention with the stretching exercise. The mean score for complaints in the initial 28 body areas with a median of 34 lowered to 32 and was considered statistically significant ($p < 0.001$). Pain intensity based on VAS value decreased significantly ($p < 0.001$) from a

From 75 FA, 34 of them participated in the stretching exercises intervention. Table 2 describes the characteristics of FA based on age, job characteristics, and level of complaints of MSDs before being given the intervention. Twenty-five research subjects were aged 18 – 39 years (73.5%) with a mean age of 35 years (SD: 9.59). A total of 15 research subjects (44.1%) had worked for 10 years or more. A total of 29 subjects (85.3%) in the study had total flight hours per month of fewer than 75 hours, with an average number of flying hours per month of 47.26 hours (SD: 16.67).

Before the intervention was given, 30 subjects (88.2%) had low levels of complaints of musculoskeletal disorders, followed by moderate levels of complaints of MSDs in three subjects (8.8%) and one subject with high levels of complaints of MSDs (2.9%). A total of 17.6% of subjects felt the intensity of pain was most significant in the waist area, followed by the right shoulder area, left shoulder, back, right knee, left wrist, hand right, right foot, upper neck, buttock, left hand, and left foot.

Table 3 shows the complaint level scores in 28 body areas (NMQ) and pain intensity in the most painful body area (based on VAS) before and after the intervention with the stretching exercise program. The statistical significance test was carried out with a non-parametric test because the distribution of the measurement values was not in normal distribution.

median value of 6 before the stretching exercise intervention to a median value of 3 after the stretching exercise. The average difference in the change in the complaint level score in 28 body areas (NMQ) was a median of 3 (-3 - 28), and the average difference in changes in pain intensity was a median of 2 (0 - 7).

IV. DISCUSSION

Based on the results of this study, the incidence of musculoskeletal disorders was relatively high. As many as 92% (n: 75) had complaints of musculoskeletal disorders with symptoms of aches, pain, or discomfort in at least one body area in the last 12 months. Similar to previous research conducted by Morley - Kirk on flight attendants in 32 countries, which found that 87% of 674 flight attendants had complaints of musculoskeletal disorders [6]. In another study by Lee et al. in a United States airline, as many as 97% (n: 185) of flight attendants experienced musculoskeletal complaints in at least one body region during the past year [7]. Revati et al. reported that 82% (n: 33) of flight attendants on several Indian airlines experienced musculoskeletal pain. In a study conducted by Irma et al. (2016) regarding low back pain in Indonesian flight attendants, it was found that 37.9% of flight attendants (n: 240) suffered from low back pain [13].

Compared with the general population, the prevalence of MSDs in this study was higher. The prevalence of MSDs in the general population in the Netherlands aged 25-64 years is 39% in men and 45% in women [14]. In Indonesia, the prevalence of musculoskeletal disorders based on existing symptoms is 24.7%[4]. This difference might be due to differences in the number of samples and not specific to the flight attendant population.

In this study, the most significant percentage of women experienced symptoms in the waist, right shoulder, back, left shoulder, and lower neck, with average pain intensity in the most painful area based on the VAS value of 5.23 (SD: 2.58). This result is in line with a study by Lee et al. and Revati, where the areas that most flight attendants complain about are the lower back region (waist and buttocks), wrists, neck, shoulders, and leg [7], [8]. The high prevalence and intensity of pain in the lower back area (waist and upper buttocks) can be caused by the job tasks of a flight attendant that require postural stress. Such as standing for a long time and bending over and pressure on the spine by pushing a heavy trolley [5]. Static posture poses a greater risk of postural stress compared to dynamic posture, which, if done for a long time, can cause continuous muscle contractions and pressure on the limbs [4].

The dominant factors that increase the risk of low back pain are flight hours and the number of sectors in the last 24 hours. Flight attendants with 9 hours of flying or more have an 82% higher risk of low back pain, and flight attendants with four or more sectors in the last 24 hours have a 53% higher risk of low back pain. The longer the flight hours of a flight attendant on both short and medium-haul flights, the more physical burdens they carry on work assignments. Flight attendants work with more frequent take-offs and landings on short and medium-haul flights. There is a work cycle on each flight, starting from the entry of passengers to the passengers getting off the plane, which must be completed in each sector along the route [13]. Pain in the neck and shoulders can occur due to repetitive

overhead activities such as closing the luggage compartment and pushing and pulling heavy trolleys [8].

In addition, the pain that arises can be caused by heels as part of the flight attendant uniform. In a study by Anindya (2019) on flight attendants who conduct periodic medical examinations at the Aviation Health Center, a significant relationship was found between shoe heel height (≥ 5 cm) on flying assignments and the incidence of low back pain in flight attendants [15]. The use of heels causes a significant increase in paraspinal muscle activation, especially in the cervical and lumbar regions, so that the muscles become tense and ultimately cause pain. The legs and lower body muscles become fatigued after 5 hours of standing, which ultimately causes pain. While serving in the cramped galley space, flight attendants perform their duties by lifting, reaching, bending, and squatting. The demands of working in a confined and narrow area lead to a lack of flexibility in choosing body positions and, in turn, cause fatigue and pain [5], [8].

Concerning the flight environment, aircrews are exposed to mild hypoxia during a flight on aircraft with pressurized cabins. Mild hypoxia that occurs during flight is acute and does not significantly affect complaints of MSDs [16]. Musculoskeletal disorders experienced by flight attendants are more related to the previously described factors, such as postural stress related to work tasks.

The most used approach to managing MSDs is stretching therapy. Several studies have shown that doing stretching exercises can reduce discomfort/pain and increase range of motion/ROM [11]. This study showed a significant change in the average complaint level score in 28 body areas (NMQ) after the stretching exercise intervention. The pre-stretching score with a median of 34 dropped to 32 after the stretching exercise. However, clinically, these values (34 and 32) are still in the same category of MSDs, namely the low level of complaints. In a study by Chika Tania (2020), two weeks of stretching exercises affected employees' MSDs complaints. The NMQ score before stretching exercises with a median of 58 dropped to a median of 37 [12]. The difference in the decrease in NMQ scores which is quite far from this study may be due to differences in the stretching exercise intervention performed. In Chika Tania's study, the Kun Anta stretch was used, with a longer duration and higher intensity of exercise than the Ministry of Health's stretching exercises used in this study.

In this study, it was found that there was a significant change in the average score of complaints in 28 body areas within two weeks. Iwan and Azizah researched Samarinda sarong weavers and found that stretching exercises succeeded in reducing MSDs [17]. Compared to Iwan and Azizah, stretching in this study was carried out with a more regular frequency, which was carried out continuously for two weeks. Meanwhile, in the research of Iwan and Azizah, although both were not specific to one muscle group, they were only carried out two times a week for one month.

Based on the study results, there were three subjects with an increase in the average score of complaints in 28 body areas.

One subject complained of pain in a previously painless area. Although two subjects experienced a decrease in the number of pain complaints areas, they complained of an increase in mild to moderate pain in the thigh and knee area. Several factors may influence this, including pain tolerance, fitness level, and delayed onset muscle soreness. Everyone has a different pain tolerance and pain threshold. Stretching above the pain threshold for a long time can result in an inflammatory response. Stretching is done well below the pain threshold because it can have an unfavorable effect if the stretch is too aggressive. Everyone's pain tolerance must be considered; for example, people with low pain tolerance are advised to do lower stretching intensities but increase the duration or frequency of their stretching exercises [18]. A person's level of fitness can affect the occurrence of exercise-related injuries. Fitness is a predictor of the risk of injury to soft tissue and bone. A person with a low fitness level is 14 times more likely to suffer lower extremity injuries than the fittest person [19]. Delayed onset muscle soreness (DOMS) is a dull sensation accompanied by stiffness that occurs 24 hours after performing unusual/familiar movements or exercises, peaking in 1-3 days and disappearing in 7-10 days. DOMS is generally associated with muscle or connective tissue damage and a subsequent inflammatory response induced by eccentric exercise. Symptoms related to acute inflammation in DOMS may also appear, such as swelling, loss of function, and pain [20].

The results also showed a significant change in pain intensity based on the VAS in the area of the body that felt the most painful before and after the intervention of the Ministry of Health's stretching exercise program. Changes were seen from the median value of 6 before the stretching exercise intervention to the median value of 3 after the stretching exercise. These results are in line with research conducted by M. Arief Gunawan (2018) regarding comparing pain intensity before and after stretching. In this study, there was a significant difference from the median VAS value of 5 (3-6) to 2 (0-3) in the neck pain of female factory workers. Stretching is done two times a day for five days in one week within two weeks [21]. There were two subjects with constant pain intensity before and after stretching in this study. This result may be because the pain felt by the subject is in the fingers, whereas in the stretching exercise, there is no specific stretching movement for the fingers. Thus, there is no change in the intensity of pain felt by the subject.

The Indonesian Ministry of Health's stretching exercises in this study consisted of several sets of movements in the neck, shoulders, arms, hands, back, waist, upper and lower legs, and feet. In theory, stretching before or after physical activity can reduce the likelihood of strains or sprains by increasing the flexibility of muscles, tendons, and ligaments, increasing the mobility of one or more joints [11]. Stretching can cause elongation of the muscle-tendon unit, reducing the maximum force, pressure, and tensile tension on the muscle tendons. Thus, stretching can change the viscoelasticity of the muscle tendons unit, so tissue stiffness tends to decrease. These changes

increase the ability of the tissue to stretch so that the possibility of injury is slighter [9]. Stretching exercises can train skeletal and cardiac muscles to increase the metabolic and functional capacity of skeletal muscles, aerobic metabolism, and peripheral responses and decrease the heart's workload. Increased heart muscle strength will increase cardiac output so that oxygen supply to tissues increases, causing smooth blood circulation to prevent the accumulation of lactic acid in the body and ultimately prevent or reduce muscle pain [12].

In several studies on stretching exercises for workers carried out in Indonesia, it was found that there was a significant effect of giving muscle stretching to musculoskeletal complaints. Ardalan et al. (2018) found that stretching exercises for 2, 4, and 6 months in office workers significantly reduced pain symptoms in the shoulders and lower back compared to ergonomic modifications. Physical therapists and occupational therapists are advised to use stretching exercises for long-term therapy rather than just ergonomic modifications [22].

Stretching exercises designed specifically for the flight population have not been widely practiced. Thomas and Greg (2016), at the United States Naval Aeromedical Conference, suggested stretching exercises before and after flying duties to treat back pain in military aircrews as prevention and self-management strategies for back pain. Stretching exercises can also be performed by targeting specific muscles or muscle groups under the supervision of a flight surgeon [23]. Another study conducted by Mike Murray et al. made a specific exercise training targeting the reduction of neck and shoulder pain in helicopter pilots and aircrews for 20 weeks where research subjects could do it themselves at home with minimal costs [24].

In the flight attendant population, there are no specific stretching exercises designed to prevent and treat symptoms of musculoskeletal disorders. Therefore, it is hoped that further research on the effects of stretching exercises and create a particular stretching program for the flight attendant population, which targets specific muscle groups adapted to work tasks.

The strength of this research is that the stretching exercises performed are easy to do, do not incur costs, and the time required is relatively short. Flight attendants can perform these stretching exercises independently, either before or after flying assignments or in between activities or free time. With online stretching exercises, flight attendants can do stretching exercises in their respective places together without gathering in one place considering the current pandemic. The limitation of this study is that the stretching exercises performed were not specific to the particular muscle group that the research subjects complained about the most. It is hoped that further research can create a particular stretching program by targeting specific muscle groups for a more extended period to better see the effect of stretching exercises.

V. CONCLUSION

A total of 69 people out of 75 flight attendants experienced musculoskeletal disorders in at least one area of the body in the

last 12 months with mild complaints. There was a significant change in the complaint level score in 28 body areas before and after the stretching exercise intervention as well as a significant change in pain intensity based on the VAS before and after the stretching exercise intervention.

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The authors acknowledge all flight attendants who participated in the study.

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Simulations to Predict Solar Energy Potential by ERA5 Application at North Africa

Nabil Esawy¹, Fawzia I. Moursy¹, U. Ali Rahoma², A. H. Hassan², Samy A. Khalil², Ashraf S. Khamees²

¹ Faculty of African postgraduate studies, Cairo University.

² National Research Institute of Astronomy and Geophysics, Solar and Space Department, Egypt.

Abstract: The design of any solar energy conversion system requires the knowledge of solar radiation data, obtained over a long period. Satellite data has been widely used to estimate solar energy where no ground observation of solar radiation is available, yet there are limitations on the temporal coverage of satellite data. Reanalysis is a “retrospective analysis” of the atmosphere parameters, generated by assimilating observation data from various sources, including ground observation, satellites, ships, and aircraft observation with the output of NWP (Numerical Weather Prediction) models, to develop an exhaustive record of weather and climate parameters. The evaluation of the performance of reanalysis datasets (ERA-5) for North Africa against high-quality surface measured data performed using statistical analysis.

The estimation of global solar radiation (GSR) distribution over six different selected locations in North Africa during ten years from the period time 2011 to 2020. The root mean square error (RMSE), mean bias error (MBE), and mean absolute error (MAE), of reanalysis data of solar radiation range from 0.079 to 0.222, 0.0145 to 0.198, and 0.055 to 0.178 respectively. The seasonal statistical analysis was performed to study seasonal variation of performance of datasets, which reveals the significant variation of errors in different seasons. The performance of the dataset changes by changing the temporal resolution of the data used for comparison. The monthly mean values of data show better performance, but the accuracy of data compromised. The solar radiation data of ERA-5 used for preliminary solar resource assessment and power estimation. The correlation coefficient (R^2) varies from 0.93 to 99% for the different selected site in North Africa in the present research. The goal of this research is to give good representation for global solar radiation to help in solar energy application in all fields, and this is can be done be using gridded data from ECMWF and produce a new model to give a good result.

Keywords: Solar energy; ERA-5 analysis data; Global solar radiation- Potential Energy

1 INTRODUCTION

In this work, we investigate the factors leading to this latest round of cost reductions from a holistic perspective, considering component pricing trends, the interests and business models of the industrial learning rates for photovoltaic system costs in the region compared to global trends. This analysis indicates that the North Africa, rather than being qualitatively different from the global market, rather benefits from a confluence of factors including favorable financing conditions, low costs of doing business, a strong presence of highly experienced project developers, both domestic and foreign, and of course a strong solar resource, that consistently yield prices that are low by global standards, but whose evolution over time is similar to global trends. Hence, the Gulf market can be seen as “advanced” relative to the global market—further down the learning curve but not

qualitatively unique—and therefore can offer into a window into the likely future trajectory of photovoltaics globally. In this case, the “crystal ball” of the Gulf market predicts that global solar electricity prices will soon enter a regime that will favor the decommissioning of large numbers of fossil fuel plants and the rapid transition to a renewable-dominated energy system. We have summarized in a cursory way what we believe to be the biggest challenges and opportunities implied by this transition. Further understanding and responding to these opportunities and challenges will be a critical goal of future work in both the technical and policy arenas.

The solar energy industry has spent decades cutting the cost of generating electricity directly from the sun. Currently, the focus is on making solar panels more powerful. With the savings reaching a high level in equipment manufacturing and pressure in recent times, the cost of decreasing more will be a catalyst. The push for more powerful solar equipment underscores that further cost reductions are still needed to drive the shift away from fossil fuels. While grid-connected solar farms are currently cheaper than more advanced coal or gas-fired plants, additional savings will be required to bring together the clean energy sources with the expensive storage technology needed to achieve zero-carbon energy around the clock.

Larger factories and the use of automation and more efficient production methods have resulted in economies of scale, lower labor costs, and reduced physical waste for the solar sector. The average cost of solar panels decreased by 90% from 2010 to 2020. Boosting power generation from each panel means developers can generate the same amount of electricity from a small-scale operation. This is potentially critical, because the costs of land, construction, engineering and other equipment, have not fallen in the same way that shingle prices have.

ϕ -f-chart is a design method was chosen to simulate the fraction of the solar energy required for the load given the PV array areas and climatic conditions. Four cities in North Africa representing different locations at southern mediterranean region are selected Tripoli, Alexandria, Tunisia and Gaza city. Tripoli City has the best performance for 73% of nominal Power followed by Alexandria about 66% and then Gaza around 63%, Tunisia City has lowest solar fraction about 59% according to the Monthly and annual solar fraction Data.

Methods and Databased

International manufacturers of solar cells: There are many international companies working in this field, including the German Solar Company - the French Alfuwatat - Etiar Solar in Italy - Kronar in Yugoslavia - Astrobor in Canada - and Heliodynaica in Brazil. And many companies in the United States and Japan and there are multinational companies as well.

Key cost metrics including CapEx and PPA price are made public for most projects in the region. Analysis of the factors contributing to generation costs can be done by evaluating the leveled cost of electricity (LCOE) as

$$\text{LCOE} = \frac{C + \sum_{i=0}^L \frac{O_i}{(1+r)^i}}{\sum_{i=0}^L \frac{E_i}{(1+r)^i}}, \quad (1)$$

where C is CapEx, O_i is operating expenses (OpEx) in year i , E_i is energy generation in year i , L is the plant lifetime in years (or the PPA duration if no residual value is assumed), and r is the

This r can be taken as the internal rate of return (IRR) of the project at a given price point or as the weighted average cost of capital (WACC) if the financing terms are known and the LCOE represents the minimum sustainable price of electricity.

Reported CapEx, PPA prices, and financing information will be summarized in the context of global market trends, along with a consideration of the different stakeholders in the projects, including developers, utilities, contractors, and financing entities, and how their interests influence the economic decision-making involved in developing them. Consideration of global learning curves for different cost metrics provide a framework for understanding how local trends are likely to manifest themselves in the global market. Synthesizing these different streams of information, we will attempt to peer into the near future of the local and global solar industry and begin to evaluate some of the likely impacts of the coming revolution in the energy sector.

Evaluating the LCOE for both sets of assumptions, we see that 90% of the drop in LCOE from MBR3 to MBR5 can be accounted for by the reduction in CapEx (Figure 2). Indeed, both MBR5 and Al Kharsaah fall at the extreme low end of the global range of PV system CapEx as reported in the most recent IEA PV Trends report,⁶¹ projects such as Al Askar that have not achieved notably low PPA prices fall in the middle of the global range. The remaining reduction can be explained by assuming a modest boost in capacity factor of 5% due to the use of bifacial modules, which has been indicated by modeling under local conditions.⁶² No further assumptions regarding OpEx or financing costs are required to reconstruct the observed PPA prices, allowing us to focus more detailed attention on explaining how such dramatic reductions in CapEx could be achieved in such a short time.

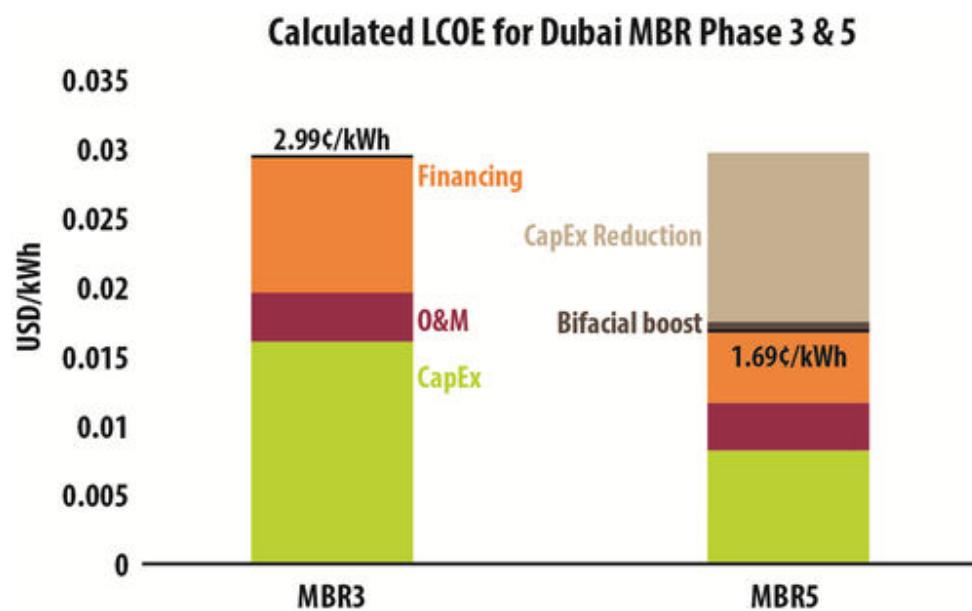
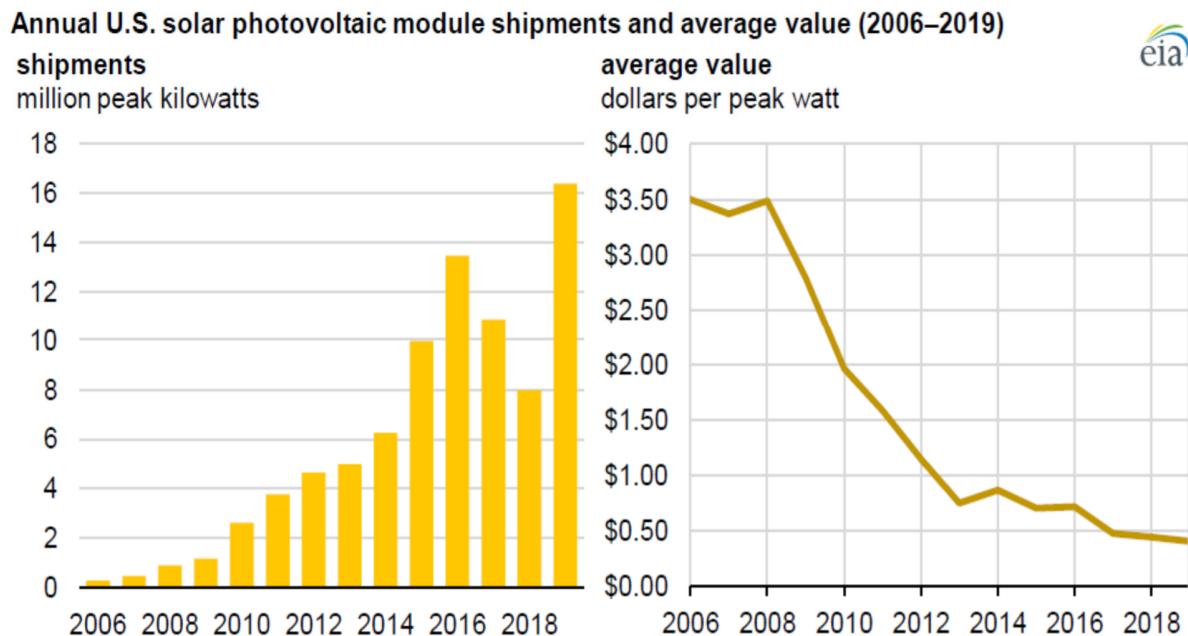


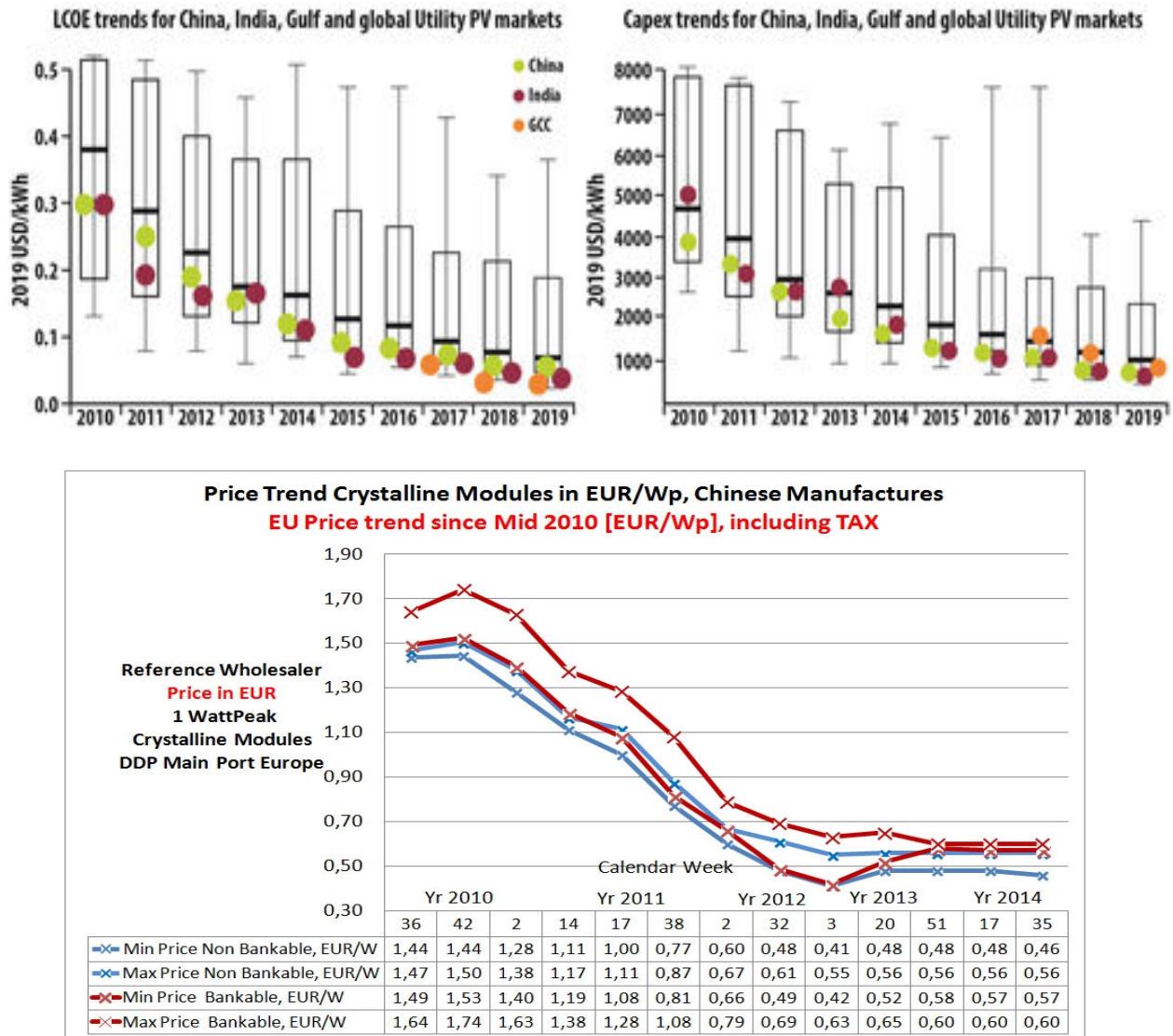
FIGURE 2

LCOE broken down into CapEx, OpEx and financing contributions for cost model of Dubai's Al Maktoum solar park phase 3 (announced 2016) and phase 5 (announced 2019). Reduction in LCOE is fully explained by modest boost in energy yield from the use of bifacial modules, and a large reduction in CapEx [Colour figure can be viewed at [wileyonlinelibrary.com](#)].

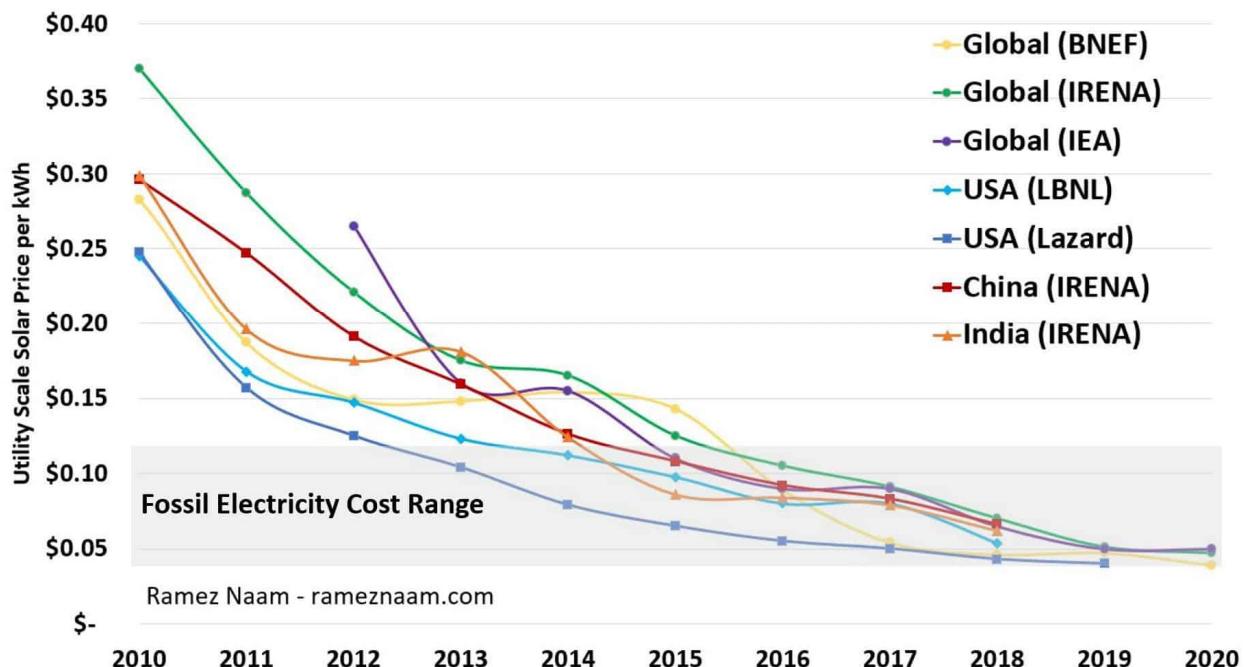


4 WHAT IS RESPONSIBLE FOR FALLING CAPITAL COSTS?

In our previous study,⁸ we used global market data combined with knowledge of the local environment and business practices to build a bottom-up model for PV system CapEx in the UAE. We found that CapEx below \$1000/kW was feasible based on rapidly declining module costs (around 30 ¢/W at the time of that writing), BOS and tracker costs, the low cost of labor in the region, and minimal overhead and “soft” costs. In June of 2020, the Saudi Minister of Energy indicated that an announcement of a record-low PPA price for a PV project would soon be announced, which is presumably a reference to the forthcoming award of the Al Faisaliah project.⁶⁸ Given that the award of Abu Dhabi's Al Dhafrah project for 1.35 ¢/kWh was widely expected at the time, this would be expected to indicate a price around 1.3 ¢/kWh, one of the clearest indications to date of significant economies of scale in 100-MW to 1-GW scale photovoltaic projects.



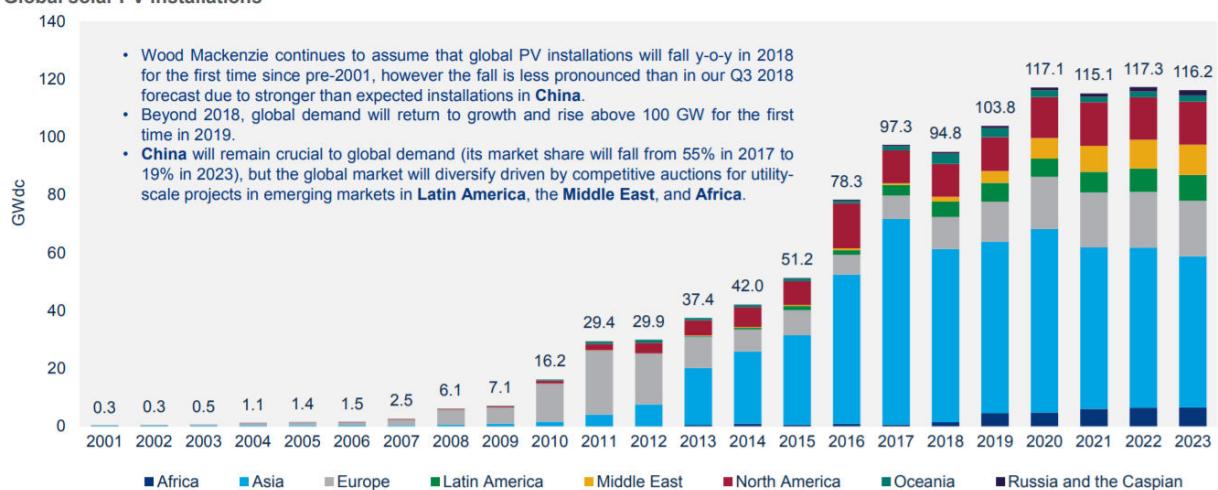
Solar Costs Dropped by a Factor of 5 Since 2010



After a muted 2018 decline, the global market will breach 100 GW in 2019

Installations will sit at 115-120 GW in early 2020s as emerging markets begin to deliver results

Global solar PV installations



Solar Choice: Solar PV system price, \$/Watt					
	1.5kW	2kW	3kW	4kW	5kW
Median					
August 2012	\$2.31	\$2.30	\$2.14	\$2.16	\$2.06
August 2016	\$2.12	\$1.86	\$1.58	\$1.44	\$1.33
% Decrease	-8%	-19%	-26%	-34%	-35%
High					
August 2012	\$4.23	\$4.25	\$4.23	\$4.29	\$4.27
August 2016	\$3.58	\$2.88	\$2.45	\$2.32	\$2.11
% Decrease	-15%	-32%	-42%	-46%	-51%
Low					
August 2012	\$1.33	\$1.50	\$1.58	\$1.65	\$1.65
August 2016	\$1.40	\$1.25	\$1.07	\$1.03	\$0.94
% Decrease	5%	-17%	-32%	-37%	-43%

Description the region

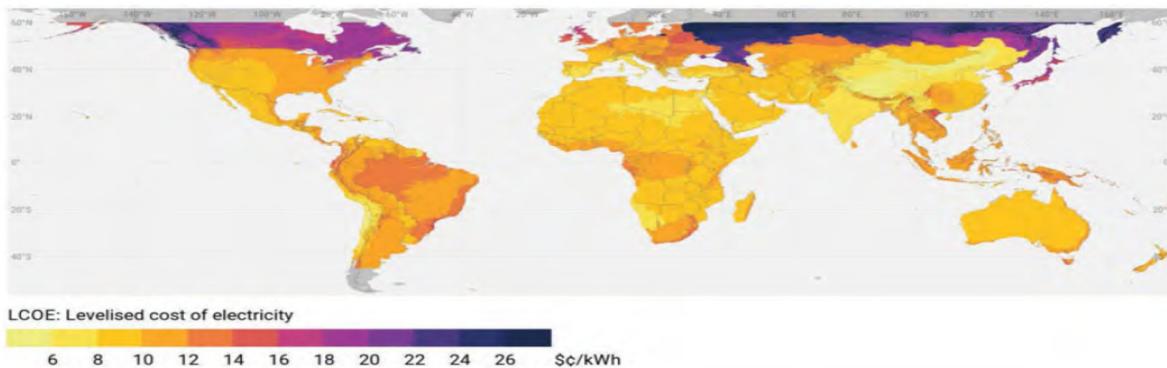
North Africa has enormous potential for solar power, but the huge investments and public support needed for large projects are a challenge for cash-strapped regional governments. While they boast some of the world's largest PV projects, countries in the region would do better to focus on smaller projects with more tangible results, say solar entrepreneurs. Egypt, the most populous Arab country with some 102 million inhabitants, has set itself the goal of achieving 42% of its electricity from renewable energy sources by 2035. The Benban solar park is the perfect embodiment of this new Egyptian ambition. Located in a desert area so vast that it can be seen from space, this colossal installation -- six million solar panels over 37 square kilometers -- is the result of a \$4 billion (€3.4 billion) project partially funded by the World Bank. However, the output of this solar park inaugurated in 2019 can light only 420,000 Egyptian homes, according to the United Nations. And in 2016, only 9% of the country's electricity came from renewable energy, according to the most recent official figures. If he considers rural Egypt and tourist complexes of the Mediterranean and Red Sea coasts suitable for the expansion of photovoltaic, the researcher assures that installing solar panels in Cairo may prove tricky "because it takes a lot of space" at the top of buildings in particular, a real challenge for a city as densely populated as the Egyptian capital housing about one fifth of the Egyptian population. Moreover, the solar panels would not manage to cover certain energy-consuming needs of the megalopolis as "the supply of the air-conditioners during the summer", specifies the specialist of the Middle East.

For each Cairo household, Raouf estimates the cost of switching to solar energy at about 60,000 Egyptian pounds (3,350 euros). "Why would we invest in an environmentally friendly technology that is expensive?" he questions. "The state must take the initiative to make (this operation) attractive," he says. In the last ten years, North Africa has increased its production of renewable energy by 40%, according to data from the International Energy Agency (IEA), but dependence

on fossil fuels remains strong. Algeria is a large oil and gas country and enjoys 3,600 hours of sunshine annually. However, renewable energies represent only 1.8% of the country's energy consumption.

Among the pioneers of green energy in the region, Morocco boasts its Noor Ouarzazate power plant, one of the largest solar complexes in the world, at the gateway to the Sahara, in the south of the country. But it is being run at a loss. "From the beginning, it was clear that the strategy was unbalanced. The error (...) is to have wanted to invest in monstrous projects that are difficult to finance," said to AFP the expert in energy control Said Guemra. For Ahmed Zahran, CEO of the Egyptian start-up Karm Solar, it is time to change the business model of selling energy to the state, based as in Benban on public-private partnerships. "The companies are focused on selling electricity to their buyer (editor's note: the state)" and are not really interested in "contributing to the infrastructure of the countries in which they operate," he says. The first private company to obtain a license to distribute solar electricity in Egypt, Karm Solar designs solar-powered buildings and water pumping systems to allow villages to have access to water and electricity without the need to use the national grid or fossil fuels. On its website, Karm Solar boasts that it has avoided the consumption of 2.3 million liters of diesel and the production of 10,000 tons of carbon dioxide per year, among other things.

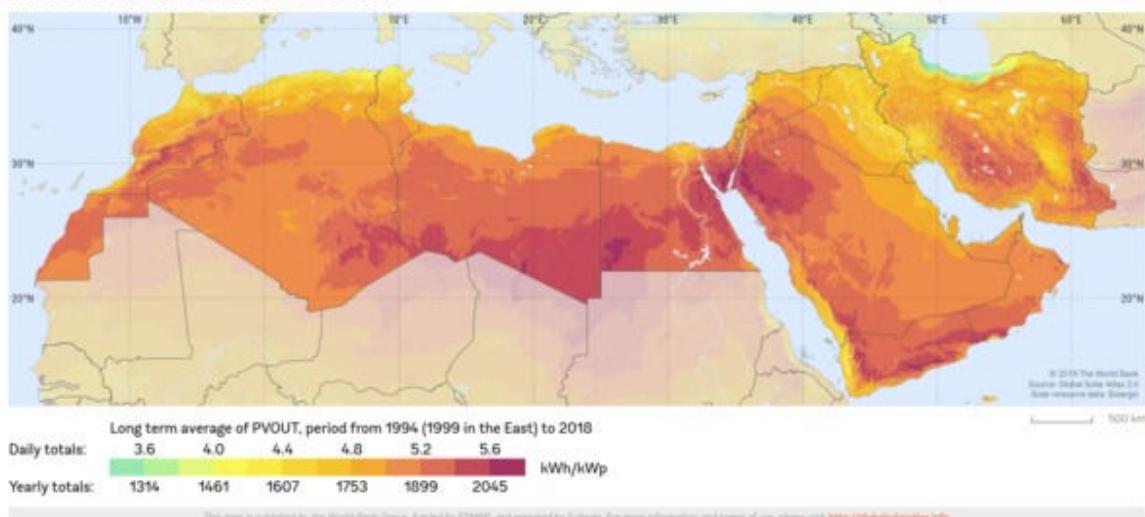
FIGURE 3.9: A SIMPLIFIED LCOE ESTIMATED FOR LARGE-SCALE GROUND-MOUNTED PV POWER PLANTS WITH EXPECTED LIFETIME OF 25 YEARS



SOLAR RESOURCE MAP
PHOTOVOLTAIC POWER POTENTIAL
MIDDLE EAST AND NORTH AFRICA

WORLD BANK GROUP

ESMAP SOLARGIS



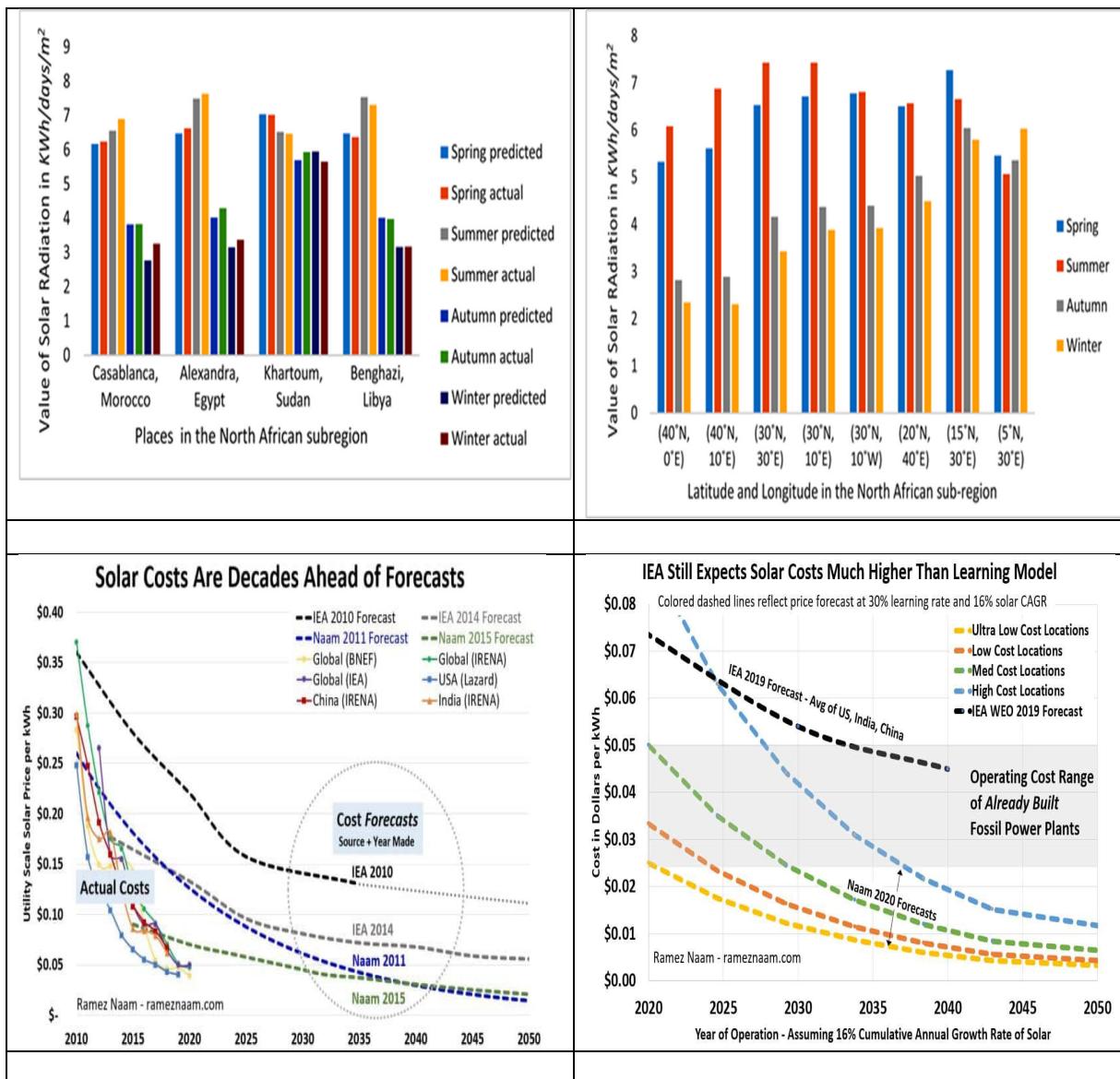


Table 1: Station of study its location and the recorded values of average annual Global Solar radiation and its cost.

Stations		Location			Radiation (KWh/m ²)	Coast (\$USD)
		Latitude(°N)	Longitude(°E)	Elevation (m)		
ElAgma	Sinai	29	33	595	5.61	42
ElArish		31	33.5	10	5.28	46
ElGolf	Western Desert	23.44	25.8	1260	6.22	37
Habatta		31	25.5	182	5.71	41
Sewa		29	25	200	5.39	45
Saffaga	Eastern Desert	26	33.7	153	5.91	39
Shiab-Elbanat		26.5	33	650	5.98	39

The PV market needs good ideas in order to stimulate the construction of medium- to large-scale solar plants in the near future. The rapid removal of market barriers by lawmakers is one possible and sensible measure, but larger tender volumes are also needed, especially for smaller players.

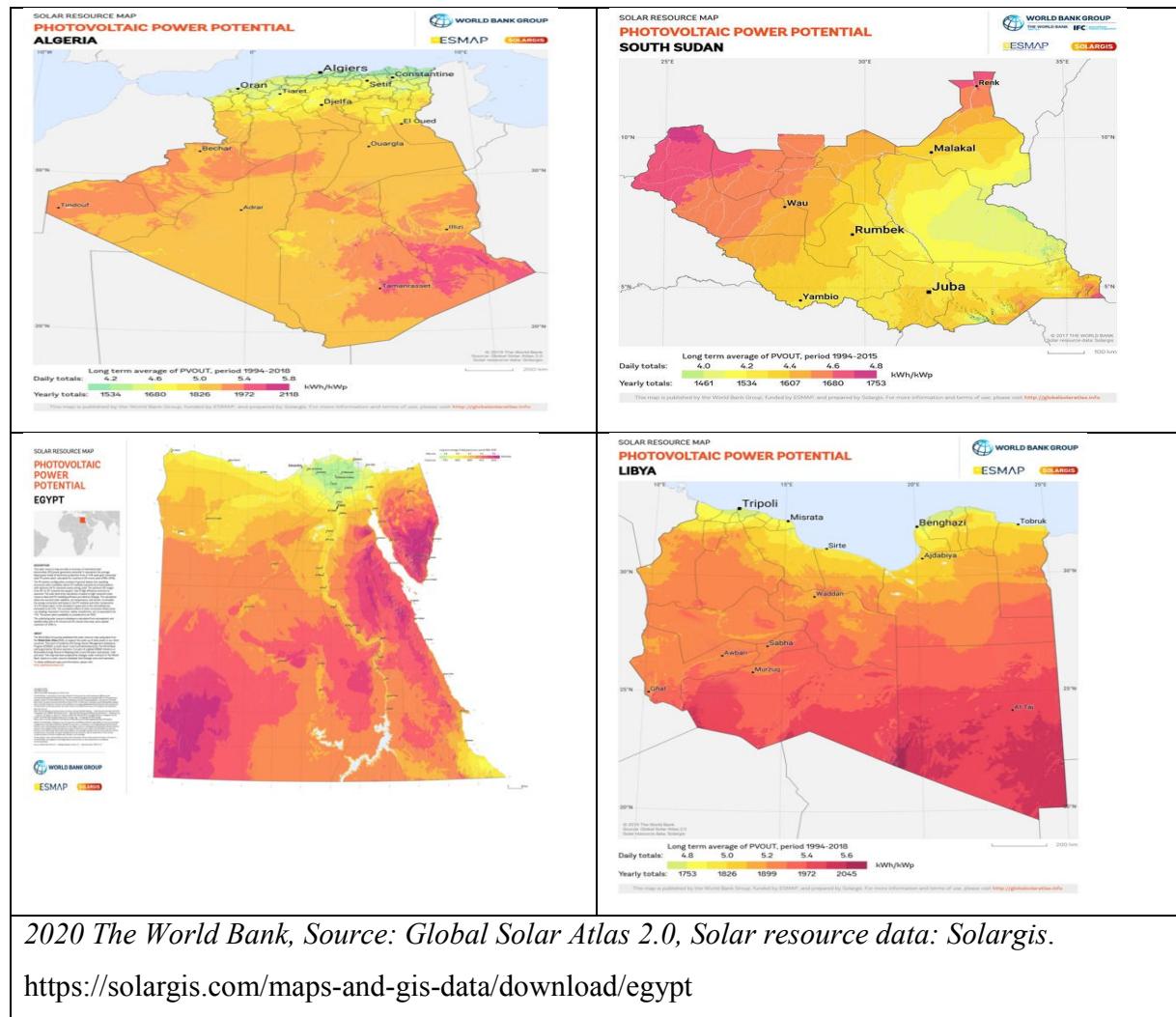
Overview of price points broken down by technology in April 2021, including changes from the previous month (as of June 14, 2021)

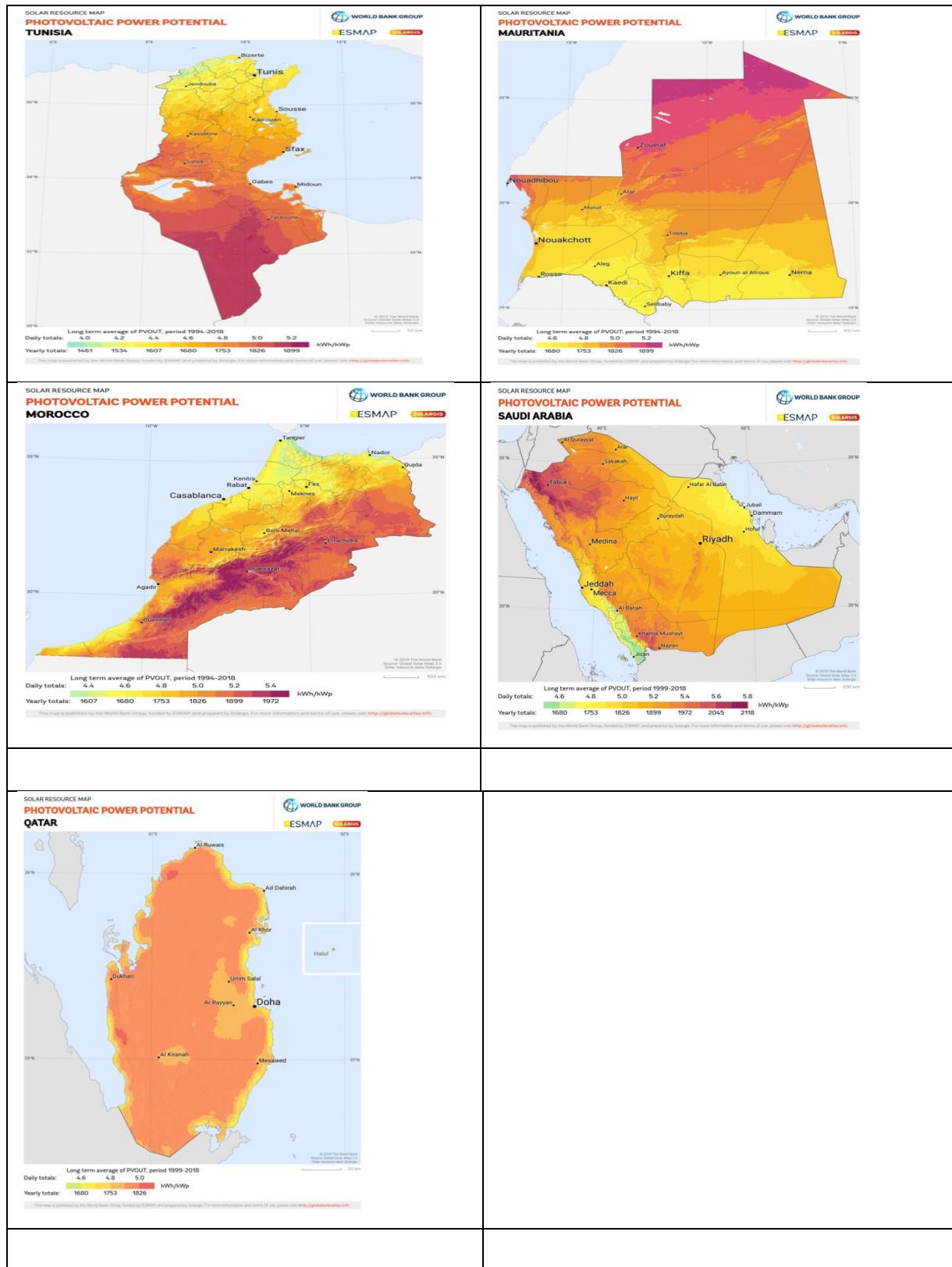
Module class	€/Wp	Trend since May 2021	Trend since Jan. 2021	Description
Crystalline modules				
Bifacial	0.37	+5.7%	+8.8%	Modules with bifacial cells, transparent backsheets, or glass-glass, framed and unframed
High efficiency	0.34	+3.0%	+6.3%	Crystalline panels at 335 Wp and above, with PERC, HJT, n-type, or back-contact cells, or combinations thereof
All black	0.35	+2.9%	+6.1%	Module types with black backsheets, black frames, and rated power between 290 Wp and 390 Wp

Mainstream	0.25	0.0%	+8.7%	Modules typically featuring 60 cells, standard aluminum frames, white backsheets, and 275 Wp to 330 Wp
Low cost	0.18	+5.9%	+12.5%	Factory seconds, insolvency goods, used or low-output modules, and products with limited or no warranty

Notes: Only tax-free prices for PV modules are shown, with stated prices reflecting average prices on the European spot market (customs cleared)

Source: pvXchange.com





Calculating Economic PV Potential By defining LCOE and calculating PVOUT, we can indicatively calculate the LCOE value of solar PV in a particular geographical reference point. However, the LCOE presented here may not reflect specific local market conditions as it is only a rough estimate due to input values being averaged and associated at the country/regional level. Regional and country-level estimates of cost (CAPEX and OPEX) are available in various solar industry publications (e.g., [20], [21]), but they are not representative enough for this work as they can be specific to regional conditions at the time of compilation and calculated by different methodologies. We use the 10165-ESMAP PV Potential-new.indd 18 6/12/20 12:42 PM 2. Methodology 19 most harmonized data set available, to give indicative cost estimates for CAPEX as a primary input into the LCOE calculation: $\text{CAPEX}_t + \text{OPEX}_t \sum_{t=1}^n (1+d)^t \text{LCOE} = \text{PVOUT}_t \sum_{t=1}^n (1+d)^t$ Key: LCOE = Average lifetime leveled cost of electricity generation CAPEX_t = Investment expenditures in the year t OPEX_t = Operations and maintenance expenditures in the year t PVOUT_t = Electricity generation in the year t d = Discount rate (WACC) n = Lifetime of the PV system in years Capital expenditure The most comprehensive information on capital investment cost estimates (CAPEX) is available in the Renewable Power Generation Cost Report 2018 by IRENA [17]. This report analyzes the CAPEX of PV power plants in 19 countries. Table 2.3 represents data for the countries with a high share of PV installed power worldwide, as reported by IRENA, as well as the global weighted average. The countries listed below have the average cost harmonized for the year 2018, including inflation and excluding local incentives. Local incentives in many countries have helped the growth of the PV sector in recent years, but they have recently been phased out. The global weighted average value of \$1,210/kW_p was calculated by IRENA using IRENA's Renewable Cost Database. The calculated value is used as an indicative estimate for all other countries.

LCOE Calculation

As seen earlier (Figure 2.1), the economic potential of solar PV power does not consider the market potential, which is site specific due to land costs, grid infrastructure, logistics, legal, and political framework.

There are various ways of assessing economic potential, including the payback period; the return on investment for the owner or operator; and the LCOE. We have chosen to focus on the concept of LCOE because it allows us to compare various power generation technologies, including a wide range of renewables and fossil fuels. Each technology might have slightly different inputs to encompass its specific requirements but, in general, LCOE is the product of all of the lifetime costs associated with construction and operation of the power plant, divided by the electricity produced during this lifetime. It can be interpreted by the following formula:

$$LCOE = \frac{\sum_{n=0}^N \frac{C_n}{(1+d)^n}}{\sum_{n=1}^N \frac{Q_n}{(1+d)^n}}$$

Key:

N = Analysis period in years

C_n = Annual project costs in the year n (\$), which include capital expenditure (CAPEX), operational expenditure (OPEX), loan financing, taxes, and incentives (if applicable)

Q_n = Electricity generated by the system in the year n (kWh)

d = Discount rate (real or nominal)

Over the years, more complex and descriptive methods of calculating LCOE have been introduced in solar energy to better encompass the specific needs of developers, engineering firms, and financial institutions. One example is given by the financial advisory and asset management company Lazard, which devised a way of calculating LCOE by focusing on the developer's internal rate of return (IRR) and working backward to calculate the resulting LCOE from the point of view of a developer or equity investor [19].

TABLE 2.3: CAPEX FOR A UTILITY-SCALE PV POWER PLANT VALUE FOR 19 SELECTED COUNTRIES IN 2018

Country Name	CAPEX [\$/kWp]	Country Name	CAPEX [\$/kWp]
Canada	2,427	Republic of Korea	1,326
Russia	2,302	Saudi Arabia	1,267
Japan	2,101	Turkey	1,206
South Africa	1,671	Indonesia	1,192
Australia	1,554	Germany	1,113
United States	1,549	France	1,074
Brazil	1,519	China	879
Mexico	1,541	Italy	870
Argentina	1,433	India	794
United Kingdom	1,362	Global Weighted Average	1,210

Source: IRENA [17].

In the last decade, the LCOE reduction in the PV industry has been dramatic [17], and further reductions over the following decade are expected. Therefore, the results presented here should be interpreted only as a snapshot for 2018, estimated from the available data. The map shows that CAPEX plays an important role in the distribution of LCOE across the globe. It is relatively high in Russia, Canada, and Japan, causing the LCOE to rise to over \$0.15/kWh even in the regions with favorable PV potential, and over \$0.20/kWh with less promising PV potential.

On the other hand, low CAPEX dramatically influences the LCOE, including in China, India, and Italy, where most of the area in the countries reach the level of \$0.06/kWh or less. LCOE for particularly large PV projects drops even lower in countries such as in the United Arab Emirates and Saudi Arabia, according to publicly available data [17].

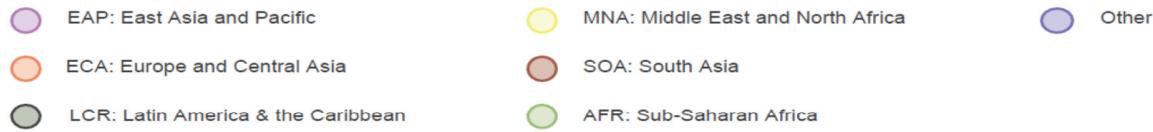
Nevertheless, the economic potential varies between \$0.06/kWh and \$0.14/kWh in most countries and over 75% of the evaluated global area scores below \$0.12, which makes solar PV competitive with conventional power-generating sources.

In addition to LCOE, we compare practical solar PV potential to a set of other socioeconomic indicators to show the solar power generation potential in the context of economic, human, and social development.

The selected indicators are described in Table 2.3 and shown in the form of bubble charts. The y-axis in all charts represents the country's or region's practical potential at Level 1, represented by the mean value of the long-term average of daily totals. The color of a bubble refers to a group of countries, or world regions, defined by the World Bank (Table 2.1, Figure 3.10). The size of the bubble represents the population. Bubbles of the largest economies in each group or the extremes are tagged with a two-letter country code (ISO-3166-1 alpha-2).

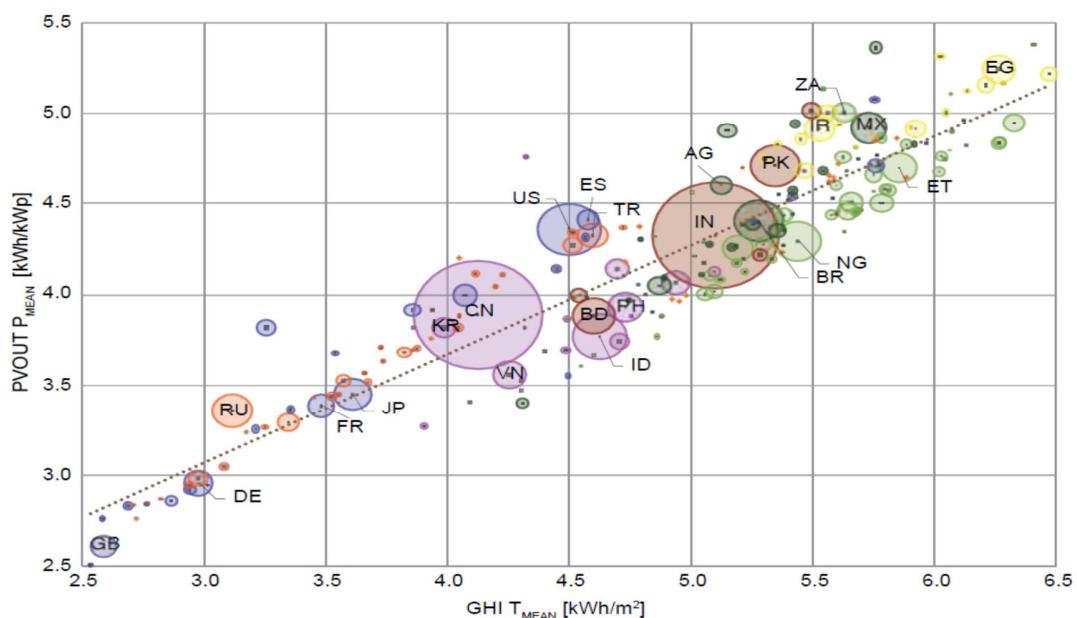
The data and graphs available in this report are also available for interactive viewing and may be downloaded from the Global Solar Atlas.

FIGURE 3.10: COUNTRY GROUPS, ACCORDING TO THE WORLD BANK, USED IN FIGURES 3.11 TO 3.19



Source: Authors.

FIGURE 3.11: AVERAGE PRACTICAL PV POWER POTENTIAL AT LEVEL 1 (PVOUT) COMPARED TO THEORETICAL POTENTIAL (GHI)

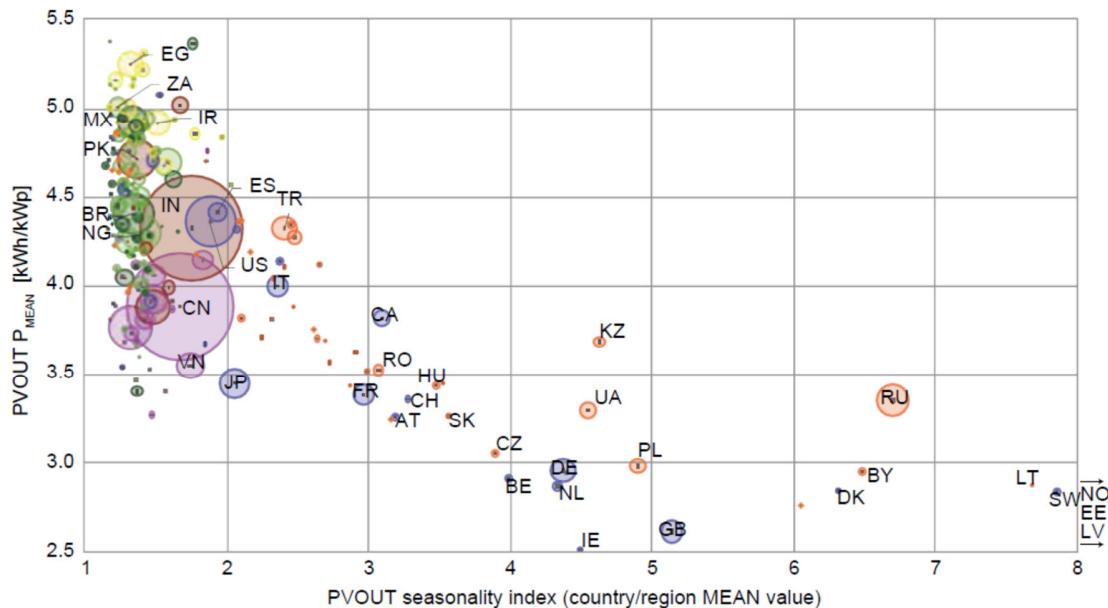


Source: Authors.

Figure 3.11 is an alternative view of the P_{mean} values presented in Figure 3.8. It shows that the theoretical potential, represented by GHI, is not fully proportional to practical PV power potential PVOUT. The main reason for this is that air temperature influences the performance of PV power plants. For the same GHI values, the specific PV power generation is higher in regions with a colder air temperature, and lower in regions with a higher air temperature.

Indonesia and Turkey are both striking examples: the mean GHI value is similar, 4.75 kWh/m^2 and 4.66 kWh/m^2 , respectively. Although Turkey has slightly lower GHI, the country's mean value of PVOUT is almost 15% higher compared to Indonesia (4.32 kWh/kWp and 3.77 kWh/kWp , respectively). Other notable cases are Nigeria

FIGURE 3.12: ABSOLUTE VALUES OF PRACTICAL PV POWER POTENTIAL COMPARED TO PV SEASONALITY INDEX



This study is accompanied by comprehensive country factsheets, which include information about theoretical, practical, and economic potential, and the position of the country in the global context of the abovementioned indicators.

Each factsheet consists of the following numerical and graphical components:

- Photovoltaic power potential map of the country with a unified color legend for all countries worldwide. Minima and maxima color intervals for the country are marked in the legend. The map also shows actual coverage of data (for some countries, the data is missing in high latitudes).
 - Country zonation map, showing how the country area is split into practical potential Levels 0, 1, and 2.
 - Indicators section presents basic country facts and statistics relevant to PV status in the country.
 - PV equivalent area value, which presumes country area proportion to be covered by PV plants producing the equivalent of yearly electricity consumption. It includes both the active area of PV modules and the area between the module rows.
 - Summary statistics provide selected results of country-based evaluation of theoretical (GHI) and practical potential on Level 1 (PVOUT). The average is considered as a representative value for each country (the countries are sorted according to this value in the ranking). Other statistics (minima, maxima, percentiles) describe the country solar power potential in better detail.
 - Distribution of a photovoltaic power output histogram communicates how much land in the country is available in practical potential Levels 0, 1, and 2, and various PVOUT ranges. It helps to understand what might be the approximate area for PV development available in the best or moderate parts of the country.
 - Monthly variation of the photovoltaic power potential details the seasonal PV electricity generation throughout a typical year; it is an important supplement to the seasonality index.
 - The bubble charts portray the position of the country in the global context of nine socioeconomic and energy-related indicators (these are analogous to the charts in section 3.3 of this report). The bubble representing the current country is highlighted, the others are in grey. The bubble size is proportional to the population of the country. Axis x represents the given indicator while axis y represents the average practical PV potential at Level 1.
- The examples of the country factsheets are presented in Figures 3.20 and 3.21. Altogether, the country factsheets for 210 countries and regions are prepared for download at Global Solar Atlas: <https://globalsolaratlas.info/global-pv-potential-study>.

Monthly solar fraction

Figures 6 through 9 represent the monthly fraction of the solar energy delivered by solar PV array each month for each city. The highest monthly solar fraction was obtained at Tripoli as shown in Figure 6. More than 79% of the energy is provided by the solar energy for the month of March and

April with a system area ($A_{\text{system}} = 80 \times 10^3 \text{ m}^2$) for 62500 solar panels and minimum solar fraction with the same area in June about 69%. Alexandria City obtained its highest monthly solar fraction in January about 73%, on the other words the solar fraction is always above 60% throughout the year as shown in Figure 7.

Gaza City obtained its highest monthly solar fraction in March and September. In addition, during summer season, a drastic drop in solar fraction is obvious in June because affected by slope angle

of PV array is fixed; in other word, incidence angle is large in June and May as well. The solar fraction reaches above 67% for september and october. The solar fraction in Tunisia City has a monthly solar fraction ranging between 51% to 62%. The Highest solar fraction obtained in March and September for PV array area equal to $80 \times 10^3 \text{ m}^2$.

4.2. Yearly solar fraction

Annual solar fraction of solar energy delivered by PV array or system as a function of system area (overall area of PV array) is shown in Figure 10. The annual solar fraction increases with the system area

(A_{system}) that means the larger system area, will give higher energy delivered. Moreover, increases ambient

temperature lead to decrease the efficiency and produced energy the factor mentioned- above effected directly on the efficiency and the energy, Tripoli has highest annually solar fraction whereas the maximum its solar fraction about 75% with larger area of the system followed by Alexandria City and then Gaza City.

Tunisia City has the lowest yearly solar fraction. whereas the maximum its solar fraction about 60%. Alexandria City and then Gaza City have solar fraction less than 75% and more than 60%.

Monthly solar fraction

Figures 6 through 9 represent the monthly fraction of the solar energy delivered by solar PV array each month for each city. The highest monthly solar fraction was obtained at Tripoli as shown in Figure 6. More than 79% of the energy is provided by the solar energy for the month of March and April with a system area ($A_{\text{system}} = 80 \times 10^3 \text{ m}^2$) for 62500 solar panels and minimum solar fraction with the same area in June about 69%. Alexandria City obtained its highest monthly solar fraction in January about 73%, on the other words the solar friction is always above 60% throughout the year as shown in Figure 7.

5. CONCLUSION

The theoretical study and evaluation of grid connected with solar electric system using PV arrays was presented. Four cities in Middle East and north Africa are selected namely; Tripoli, Alexandria, Gaza and Tunisia were representing different locations within southern Mediterranean basin. The Bird model was used to estimate solar radiation components. Tripoli City has the best performance on both monthly and yearly solar fraction, followed by Alexandria City and then Gaza City. Tunisia City has the lowest yearly solar fraction. An economic analysis must be carried out to determine the economic feasibility of such system in southern Mediterranean region.

The mean daily global solar radiation has been considered in this study as dependents of locational and seasonal factors while the data for the African continent were used for illustrating the methodology adopted. The new models obtained were presented in closed form for the five subregions of Africa. The novelty in this paper is that accurate, reliable and computationally less burdensome empirical models with a few input factors were developed for use as predictive tools in estimating global solar radiation derivable for any location. This study also affirms the latitude as the dominant locational factor. In addition, the domain of application in the study is the largest so far. Finally, the new models featured optimal performance in respect of estimating global solar radiation for any practical application. The theoretical study and evaluation of grid connected with solar electric system using PV arrays was presented. Four cities in Middle East and north Africa are selected namely; Tripoli, Alexandria, Gaza and Tunisia were representing different locations

within southern Mediterranean basin. The Bird model was used to estimate solar radiation components. Tripoli City has the best performance on both monthly and yearly solar fraction, followed by Alexandria City and then Gaza City. Tunisia City has the lowest yearly solar fraction. An economic analysis must be carried out to determine the economic feasibility of such system in southern Mediterranean region.

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Impact of a Solar System Designed to Improve The Microclimate of an Agricultural Greenhouse

Nora Arbaoui*¹, Rachid Tadili¹

¹Mohammed V University of Rabat, Faculty of Science, B. P 1014 Rabat, Morocco

Abstract

The improvement of the agricultural production and food preservation processes requires the introduction of heating and cooling techniques in greenhouses. To develop these techniques, our work proposes a design of an integrated and autonomous solar system for heating, cooling and production conservation in greenhouses. The hot air produced by the greenhouse effect during the day, will be evacuated to compartments annexed in the greenhouse to dry the surplus agricultural production that is not sold on the market. In this paper we will give a description of this solar system and the calculation of the fluid's volume used for heat storage that will be released during the night.

Keywords: solar system - agricultural greenhouse - heating - cooling - storage - drying.

Verification of Satellite and Observation Measurements to Build Solar Energy Projects in North Africa

Samy A. Khalil and U. Ali Rahoma

Solar and Space Department, National Research Institute of Astronomy and Geophysics (NRIAG), Cairo, Egypt.

(E-mail:usamaalirahoma@yahoo.com; samynki@yahoo.com)

Abstract: The measurements of solar radiation, satellite data has been routinely utilize to estimate solar energy. However, the temporal coverage of satellite data has some limits. The reanalysis, also known as "retrospective analysis" of the atmosphere's parameters, is produce by fusing the output of NWP (Numerical Weather Prediction) models with observation data from a variety of sources, including ground, and satellite, ship, and aircraft observation. The result is a comprehensive record of the parameters affecting weather and climate. The effectiveness of reanalysis datasets (ERA-5) for North Africa was evaluate against high-quality surfaces measured using statistical analysis. Estimating the distribution of global solar radiation (GSR) over five chosen areas in North Africa through 10-years during the period time from 2011 to 2020. To investigate seasonal change in dataset performance, a seasonal statistical analysis was conduct, which showed a considerable difference in mistakes throughout the year. By altering the temporal resolution of the data used for comparison, the performance of the dataset is alter. Better performance is indicate by the data's monthly mean values, but data accuracy is degraded. Solar resource assessment and power estimation are discusses using the ERA-5 solar radiation data. The average values of mean bias error (MBE), root mean square error (RMSE) and mean absolute error (MAE) of the reanalysis data of solar radiation vary from 0.079 to 0.222, 0.055 to 0.178, and 0.0145 to 0.198 respectively during the period time in the present research. The correlation coefficient (R^2) varies from 0.93 to 99% during the period time in the present research. This research's objective is to provide a reliable representation of the world's solar radiation to aid in the use of solar energy in all sectors.

Keywords: solar energy, ERA-5 analysis data, global solar radiation, North Africa

1. Introduction:

The measurement of solar radiation requires costly equipment such as Pyranometers. Unfortunately, for many developing countries, due to the price, upkeep costs, and calibration needs of the measurement equipment, this sort of device is not readily available. Empirical models (EMs) are frequently use to estimate solar radiation from existing meteorological characteristics in situations when solar radiation measuring instruments are hard to come by. Data on solar radiation are necessary at every stage of a solar project. Before construction, long time series of historical data is necessary to quantify the solar resource and its variability. During operation, real-time data

are typically necessary to verify the performance of the system and detect problems. In both cases, the required data may be obtain from measurement, modeling, or a combination of both. Measurements are usually not exclusively use for different reasons: (1) long time series of measured data do not exist at most locations in the world; (2) even if they exist, they most likely contain gaps that must be filled by modeling, and (3) conducting quality measurements is considerably more costly than operating models [1]-[3].

The five countries in the North Africa region have varying socioeconomic and energy circumstances, but both energy importers and large net exporters of oil and gas are align on the imperative of transitions, and several countries are at the forefront of the continent's energy transformation. During a virtual dialogue organized by the IEA, the publishing of this new publication gave stakeholders and experts from the region the chance to assess the current situation and share lessons learned about how to encourage future development. Across the region, countries show examples of energy transition initiatives and clear-sighted policies that have demonstrated tangible results and reveal the potential ahead. By adding 4.5 GW of wind, solar PV, and solar thermal capacity to its renewable energy power fleet during the past 10 years, North Africa has been able to raise its renewable energy production by 40% (<https://www.iea.org/commentaries/north-africa-s-pathways-to-clean-energy-transitions>). Over the last 10 years, the capacity of renewable energy sources increased by 80% and by about 560% when hydropower is exclude. Countries are progressively developing unique policies to support energy transitions as technologies have advanced and costs have decreased [4]-[6].

These data are unavailable for several nations. Therefore, different approaches have been using to fill in the gaps in the global network of solar radiation monitoring for sites where measured data are not available [7].

Although there are restrictions on the temporal coverage of satellite data, it has been routinely utilizing to estimate solar radiation in areas where there are no ground-based solar radiation observations available. Using reanalysis data is a different option. Reanalysis, also known as "retrospective analysis" of the atmosphere's parameters, is produce by combining the results of numerical weather prediction (NWP) models with observation data from a variety of sources, including ground, satellite, ship, and aircraft observation [8]. The result is a comprehensive record of the parameters affecting the weather and climate.

The transition to more environmentally friendly energy use in North Africa goes beyond only taking advantage of the region's substantial renewable energy potential. Over the past two decades, energy intensity has virtually been flat, indicating that there are significant opportunities to encourage greater energy-efficient use in all industries. Energy efficiency projects have faced a range of obstacles, from insufficient institutional capacity to the inability to develop the markets required to attract the necessary investment [9]–[11].

The European Centre for Medium-Range Weather Forecasts (Medium-range weather) generation reanalysis dataset, known as ERA5, has an hourly temporal resolution and a spatial resolution of 31 km. Records in this collection date all the way back to 1950 [8]. The main target of this study is the evaluation of the performance of reanalysis datasets (ERA-5) for North Africa against high-quality surface measured data performed using statistical analysis. The estimation of global solar radiation (GSR) distribution over in North Africa during one decade.

2. Area under Studies

Fig. 1 shows the annual average intensity of solar radiation over the surface of the earth. Research has shown that “black dot” areas could provide more than the entire world's total primary energy demand, assuming that a conversion efficiency as low as 8% is achieved [12]. In contrast, Africa is home to some of the world's sunniest locations, other than Africa (such as the southwestern United States, Central and South America, North and Southern Africa, the Middle East, the desert plains of India, Pakistan, Australia, etc.). Such potential is only limited to generate 125-gigawatt hours (GWh) from a 1 km² land area, according to theoretical estimates of concentrated solar power (CSP) and PV solar energy in Africa [13]. According to estimates by Hang et al. [14], the wasteland in China's northern and western areas, where solar radiation is among the strongest in the nation, has a capability to generate 1300 GW of power across an area of around 6300 km². However, according to the National Renewable Energy Laboratory (NREL) in the US, the potential for solar energy in the country is 400 zettawatt hours (ZWh) per year [15], which is a vast improvement over the country's present electricity generation capacity of 22,813 terawatt hours (TWh) [16]. Morocco, a country in northern Africa that receives around 3000 hours of sunshine annually, recently unveiled one of the largest solar energy projects in the world (using both PV and CSP technologies), with a planned generation capacity of 2000 MW (MW) by 2020 [17].

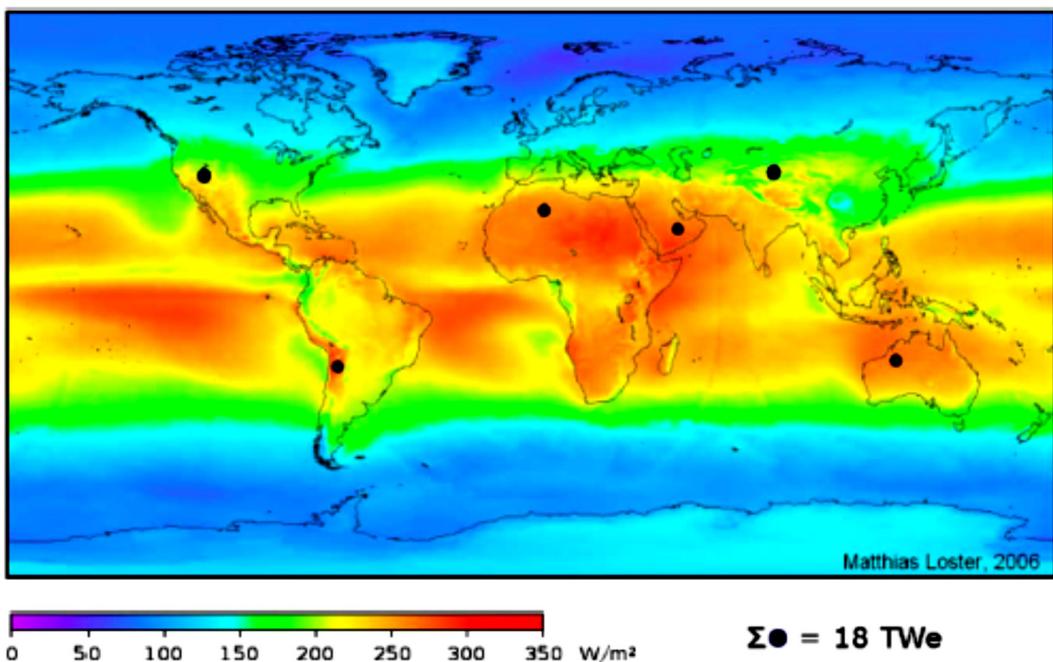


Fig. 1: Annual average solar irradiance distribution over the surface of the Earth [13].

Diversifying its economies and lowering its emissions intensity will enable North Africa to convert its resource endowments into sustainable economic growth. Even in nations like Algeria and Libya, where oil and gas resources have long constituted the backbone of the economy, energy transformations are internalize. Large fossil fuel exporters in the region, whose development models mainly rely on fossil fuels, now confront severe issues as clean energy transitions pick up

speed [18]. Fig. 2 shows the distributions of direct normal irradiation in the Middle East and North Africa

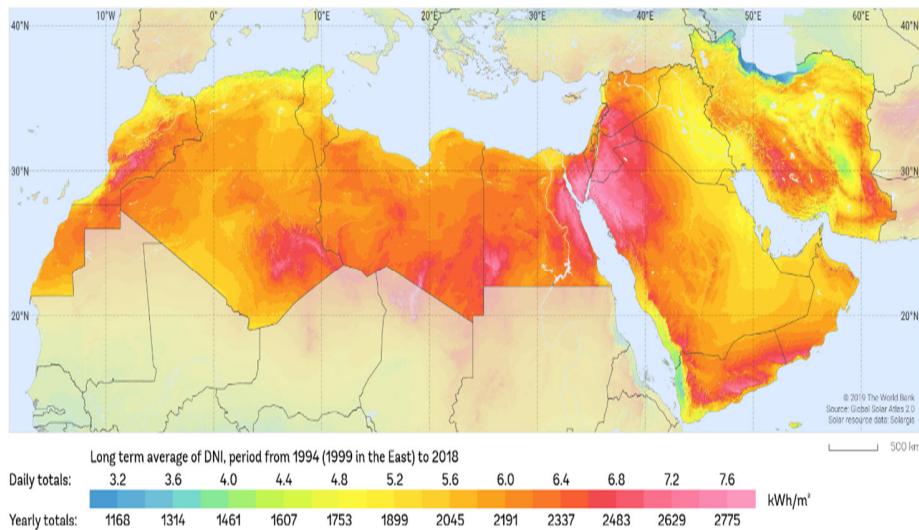


Fig. 2: The distributions of direct normal irradiation in the Middle East and North Africa.

Heat engines and photovoltaics are used in solar-powered electrical generating. Only human inventiveness can restrict the usage of solar energy. Solar applications include daylighting, solar hot water, solar cooking, and high-temperature process heat for industry, drinkable water via distillation and disinfection, and space heating and cooling through solar architecture. Solar panels are the most popular method for capturing solar energy. Depending on how they capture, transform, and distribute solar energy, solar technologies are often classified as either passive solar or active solar. Photovoltaic panels and solar thermal collectors are two active solar energy-harvesting methods. A structure can be oriented toward the Sun, materials can be chosen for their advantageous thermal mass or light dispersion capabilities, and spaces can be designed to naturally circulate air [19].

A market prediction made by the industry predicts that by 2018, the yearly PV market in Africa would grow to 2.2 GW because of falling solar equipment costs. The enormous surface area of several perennially sunny African countries, such as Egypt, Libya, Algeria, Niger, Sudan, South Africa, and Namibia, allowed for the cost-effective and large-scale development of their abundant solar resources. The temperature at which your solar panels are operating is one of the major factors impacting how much electricity they generate. It is simple to assume that more sunlight and, thus, more heat lead to more power, but this is incorrect. Although different solar panels respond to operating ambient temperatures differently, all solar panels lose efficiency as the temperature rises. As the temperature coefficient, the effect of temperature on solar panel efficiency is uncertain. You can find a phrase that has typically referred to the temperature coefficient T_{max} in the datasheet that was provided by the manufacturer of your solar panel. This statistic, which is typically expressed as a negative percentage, illustrates how temperature affects the panel. The temperature coefficient percentage shows the change in efficiency as the temperature rises or falls by one degree because solar panels are power tested at 25°C. For instance, if a particular type of panel's temperature coefficient is -0.5%, its maximum power will drop by 0.5% for every 10°C increase. Therefore, a panel with a temperature coefficient of -0.5% would result in a maximum power output drop of 10% on a hot day when panel

temperatures may exceed 450°C. On the other hand, if it were a bright winter morning, the panels would function better. The temperature coefficients of various solar cell types are described here [20]–[24]. Both monocrystalline and polycrystalline cells have a temperature coefficient T_{max} of between -0.45% to -0.50%. First off, companies that manufacture the panels utilize a thermally conductive base to assist the glass layer evacuate extra heat. By raising the solar panels a few inches off the roof during installation, the solar panel installer will also make an effort to ensure that there is a free flow of air above and below the solar panels. In order to aid in the passage of air around the solar panels, it is also possible to install ventilation devices or fans to your solar PV system. When picking the location for your solar PV installation, it is crucial to make sure that you try to locate your panels where there is good natural ventilation. Fig. 3 clearly shows the global horizontal irradiation in the Middle East and North Africa [25]

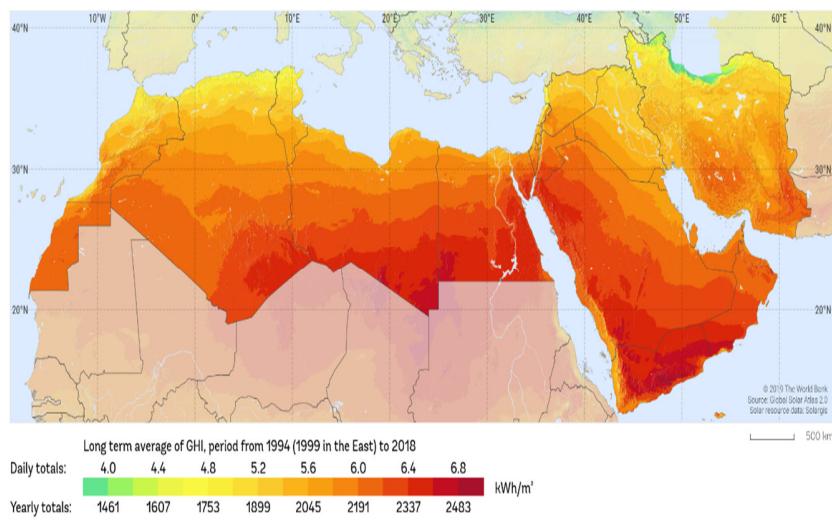


Fig. 3: Global horizontal irradiation in Middle and North Africa

Experiences in Egypt are noteworthy. By installing 25.5 GW of new generating capacity between 2015 and 2019, the nation shifted from having persistent power shortages to having a 25% surplus of electricity supply. This comprised 840 MW of new wind power and 1 GW of solar PV. A key takeaway from this transformation is that it is perfectly feasible to solve current energy issues while also making plans for a more sustainable future. It first established feed-in tariffs in 2014 and then permitted long-term power purchasing agreements in 2017 to increase the appeal of investments made by independent power producers. The construction of the 1.8 GW solar PV Park at Benban, which will be among the largest solar plants in the world once finished, was a concrete outcome of these two strategies. It also opened up projects for tendering using auction methods at the same time. This has been demonstrated to be effective for wind and solar projects, notably the construction of the 200 MW Kom Ombo solar PV plant (part of 600 MW of solar capacity tendered in auctions in 2018). By permitting investment guarantees, liberalizing its currency, and undertaking an efficient and rigorous reorganization of power subsidies, Egypt also improved its business climate. Morocco, which alone accounted for three-quarters of the region's rise in renewable electricity production, is another important example. Again, coordinated government policy has served as the foundation for the energy transitions process' tremendous accomplishments (<https://www.iea.org/commentaries/north-africa-s-pathways-to-clean-energy>)

transitions). By 2030, Morocco plans to supply 42% of its electricity from renewable sources. That goal was raised to 52% at COP21 in Paris in 2015, and it now anticipates reaching it five years early. By 2030, the nation is on track to reach a 60–65% renewable electricity share [26]–[28].

Morocco intended to establish the legal and regulatory framework for the implementation of its broader transitions strategy, focusing initially on market creation, in addition to setting long-term goals and enshrining the right to sustainable development in the constitution. Following that, legislation was passed allowing large-scale solar and wind projects and built through auctions, which boosted private sector investment. Other factors that contributed to success were assuring strong institutional off-takers, boosting institutional capacity, and building effective "one-stop-shop" institutions like the Moroccan Agency for Sustainable Development (MASEN). Morocco has successfully put two wind projects into operation this year thanks to its tenacious adherence to its strategy and the ambiguous climate of 2020. The nation is not sitting back on its laurels, but it now intends to boost the penetration of renewable energy by incorporating this into its larger view of regional integration and commerce. Morocco has established connections with Spain and Algeria in addition to guaranteeing priority dispatch for renewable energy sources. It is currently looking to further integral into other markets in North and Sub-Saharan Africa as well as Europe. For instance, although facing some particular difficulties, Libya has developed its National Energy Efficiency Action Plan (NEEAP), implemented plans to replace inefficient lighting with LEDs, and organized the implementation of rules against inefficient equipment. It expects that by doing this, energy efficiency will increase wherever it is possible in the residential sector and in public buildings [29]. Meanwhile, the globe has acknowledged Tunisia as having some of the best energy efficiency policies. In part as a reaction to the nation's status as a net energy importer. As early as 1985, Tunisia designated energy efficiency a national goal. Since then, it has demonstrated how the entirety of a legal and institutional framework, along with financial incentives, may be used to advance energy saving goals, setting a regional precedent. The National Agency for Energy Conservation (ANME), which is in charge of establishing the nation's policies, has institutional strength, which has something to do with this achievement. An integrated strategy based on six steps was introduced by ANME, including mandatory energy audits, building codes, and technological, regulatory, and fiscal tools to promote the adoption of efficiency. The establishment of a national Energy Transition Fund, which offers subsidies and loans to finance investment measures focused at energy efficiency, was one important component of Tunisia's approach. The Fund is financed through levies on high-energy-consumption goods and by development cooperation. It has a measurable return: Following the investments made, every dinar invested by the Fund resulted in a saving of 8 dinars on electricity costs. Because of this, and in contrast to the general regional trend, Tunisia has seen a decoupling of economic development and energy demand since 2001. Yet more is yet conceivable. An examination by the IEA reveals significant room for advancement in the building, transportation, and industrial sectors. According to the Africa Case, where improved energy efficiency measures are implemented, the increase in electricity consumption in North Africa is constrained to 35% by 2030, which is 11 percentage points less than what it would be without these improved measures [30]. The region could gain from increasing transportation economy through obligatory fuel requirements, financial incentives for fuel efficiency, and rules governing the fleet age of cars. Since transportation is the energy sector with the fastest growth due to ongoing urbanization and rising car ownership, such actions can have a big impact. The number of energy-efficient buildings could also have an impact on the rate of increase in energy consumption. Enhancing building energy performance codes with a focus

on building insulation is among the low-hanging fruit. Even appliances can be improved in efficiency. By 2030, cooling demand is predicted to rise by about 55%, which may be attributed to a combination of factors including an increase in the number of hot days due to climate change and an increase in the number of air conditioners being used because of increased incomes and living standards. By increasing minimum energy performance requirements and labelling, it is possible to cut the growth in cooling energy demand by 14% [31]–[33].

However, through opportunities for emissions intensity reduction and macroeconomic diversification, bringing the hydrocarbon industry into compliance with energy transitions may be in countries' best interests. Despite producing less than 4% of the world's oil and gas, the region producers' combined methane emissions in 2019 were 10 million tons, or around 12% of worldwide oil and gas methane emissions. Additionally, 10% of the world's flared gas volumes, or about 15 bcm, originate in North Africa, exposing a significant lost economic and environmental opportunity. According to IEA estimates, there are numerous cost-effective alternatives; therefore, 40–55% of methane emissions in the area might be avoided at no net cost. Transitions also give rise to the prospect of transversal diversification plans, in which nations can use their current knowledge, managerial and technical skills, as well as industry and capacity assets, to create new markets. The nations of North Africa have provided numerous instances of energy transition Programmes and policies that have produced noticeable benefits under various conditions and contexts. The accomplishments across countries in North Africa can serve as a lesson to regional and continental counterparts, from the expanded deployment of renewable energy in Morocco and Egypt to the excellent pursuit of energy efficiency in Tunisia. For oil and gas producers like Algeria and Libya, the need for energy transitions is becoming more pressing, but the chance to use the sector's current expertise to support efforts at economic diversification might be quite promising. Governments in the region are encouraged to increase their efforts and objectives, and the IEA is prepared to support them [29]–[31].

3. Description Based Data

To study Solar Radiation over Africa stations with ground observation selected, these measured data were used to evaluate the reanalysis data from ECMWF (ERA5) datasets, the result of the comparison between measured data and reanalysis showed that the best fitting between ERA5 and measured data are found in two stations Aswan and Nouakchott. While in other, stations were found to overestimate as shown in Alger and Tripoli. Solar irradiation data are available from several sources and in several formats but are generally not available as high-resolution data (for solar irradiation data see SWERA1). The solar irradiation data used in our analysis come from the HelioClim2 database and were provided by ParisTech.3 HelioClim data are derived using the Heliosat method, which converts images acquired by meteorological geostationary satellites into data and maps of solar radiation received at ground level. The relevant data come from HelioClim-3 (2004- 2010) with a step (raster size) of 0.25° (equal to about 28 km at the equator). The maps were provided by the Centre Energétique et Procédés (CEP) at MINES ParisTech in ESRI ASCII GRID4 format. They contain average data (between 2004 and 2010) of the annual amount of radiation (GHI and DNI) in kWh/m²/year [32].

4. Statistical Methods

The accuracy and performance of the derived correlations in predicting of global solar radiation were evaluated because of the following statistical error tests; mean bias error (MBE), root mean square error (RMSE), mean percentage error (MPE), coefficient of determination (R^2) and t-Test statistic. These error indices are defined as [33]:

$$\text{MBE} = \frac{1}{n} \sum_{i=1}^n (H_{i,m} - H_{i,c}) \quad (1)$$

$$\text{RMSR} = \sqrt{\frac{1}{n} \sum_{i=1}^n (H_{i,m} - H_{i,c})^2} \quad (2)$$

$$\text{MPE} = \frac{1}{n} \sum_{i=1}^n \left(\frac{H_{i,m} - H_{i,c}}{H_{i,m}} \right) \times 100 \quad (3)$$

$$R^2 = 1 - [\sum_{i=1}^n (H_{i,m} - H_{i,c})^2 / \sum_{i=1}^n (H_{i,m} - H_{m.avg})^2] \times 100 \quad (4)$$

$$t\text{-Test} = \frac{\sqrt{(n-1)(MBE)^2}}{\sqrt{(RMSE)^2} - \sqrt{(MBE)^2}} \quad (5)$$

5. Results and Discussions

The results of the present research comparison between the ground observation data and the set data from ERA5 for different locations in North Africa during the period time from 2011 to 2020. The average monthly analysis between Era interim (ERA5) and the measured data during the period time from 2011 to 2020 at different locations in North Africa is shown in Fig. 3 to Fig. 13. These figures display of the average monthly global solar radiation and estimated values by ERA5 and scatter plot between measured and Reanalysis data ERA5 of GSR for selected sites in North Africa in the present research. From these figures, we indicated that the monthly average of global solar radiation (KWh/m^2) as seen from ERA5 gives an almost good approximation to the measured data in winter, spring, and autumn months for all locations in the present study. The determination coefficients (R^2) for all sites in this research during the period time from 2011 to 2020 were over 0.92. The average monthly statistical parameters; mean bias error (MBE), root mean square error (RMSE), mean percentage error (MPE%), correlation coefficient (R^2), and t-statistics (t-Test) of the selected locations in North Africa during the period time from 2011 to 2020 are clear in a Table 1. From this table, we indicate clearly that the values of MBE, RMSE and MAE were lower than the experimental error. The correlation coefficient (R^2) values for all months in the present study exceeded 0.89 and the highest value is 0.97.

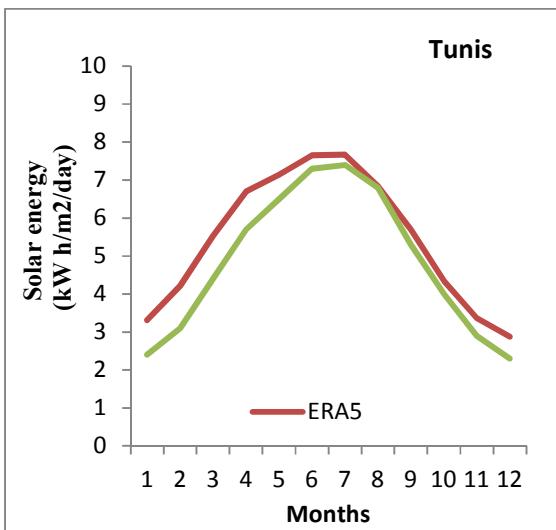


Fig. 4: The average values of GSR (KWh/m²) measured data, GSR (ERA5) estimated for Tunis site during the time from 2011 to 2020 in the present research.

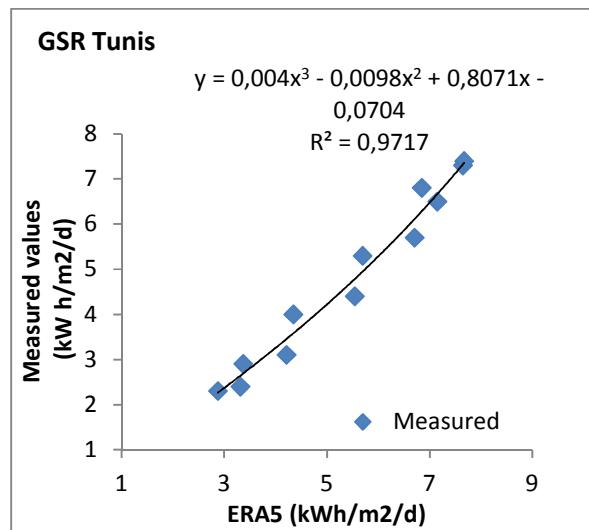


Fig. 5: Scatter plot between Measured and Reanalysis data ERA5 of GSR in Tunis in the present study.

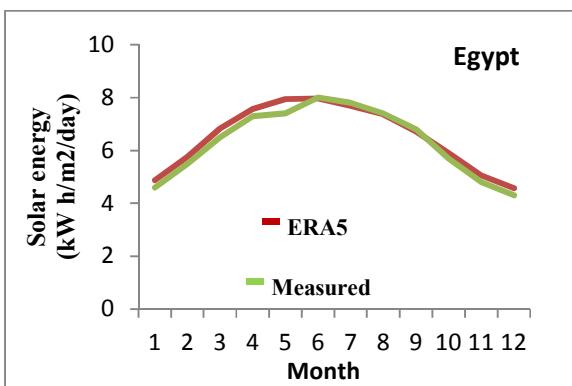


Fig. 6: The average values of GSR (KWh/m²) measured data, GSR (ERA5) estimated for Egypt site during the time from 2011 to 2020 in the present research.

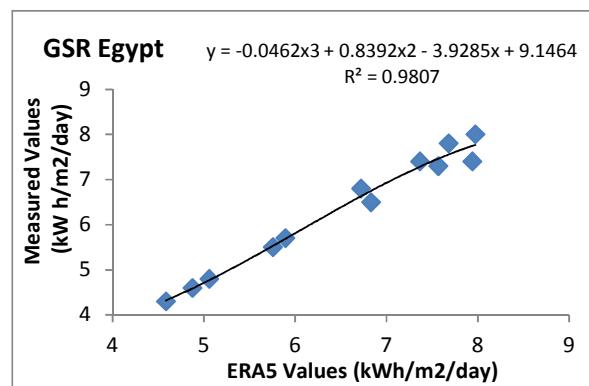


Fig. 7: Scatter plot between Measured and Reanalysis data ERA5 of GSR for Egypt in the present study.

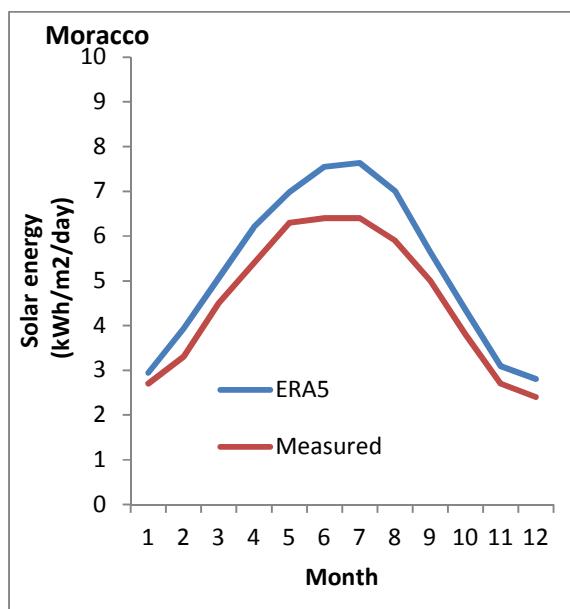


Fig. 8: The average values of GSR (KWh/m^2) measured data, GSR (ERA5) estimated for Morocco site during the time from 2011 to 2020 in the present research.

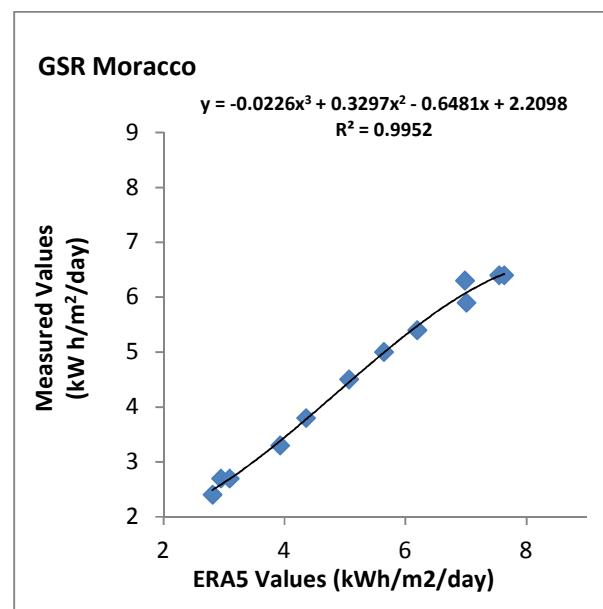


Fig. 9: Scatter plot between Measured and Reanalysis data ERA5 of GSR for Morocco in the present study.

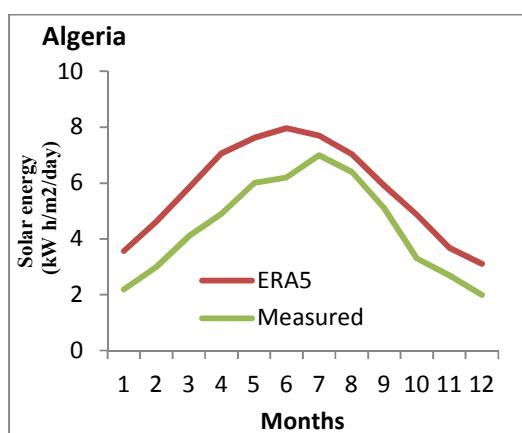


Fig. 10: The average values of GSR (KWh/m^2) measured data, GSR (ERA5) estimated for Algeria site during the time from 2011 to 2020 in the present research.

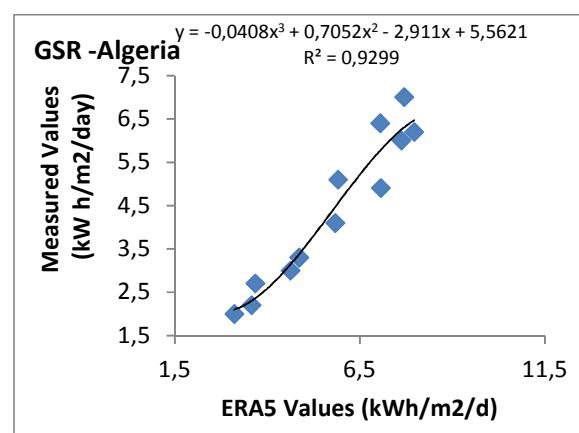
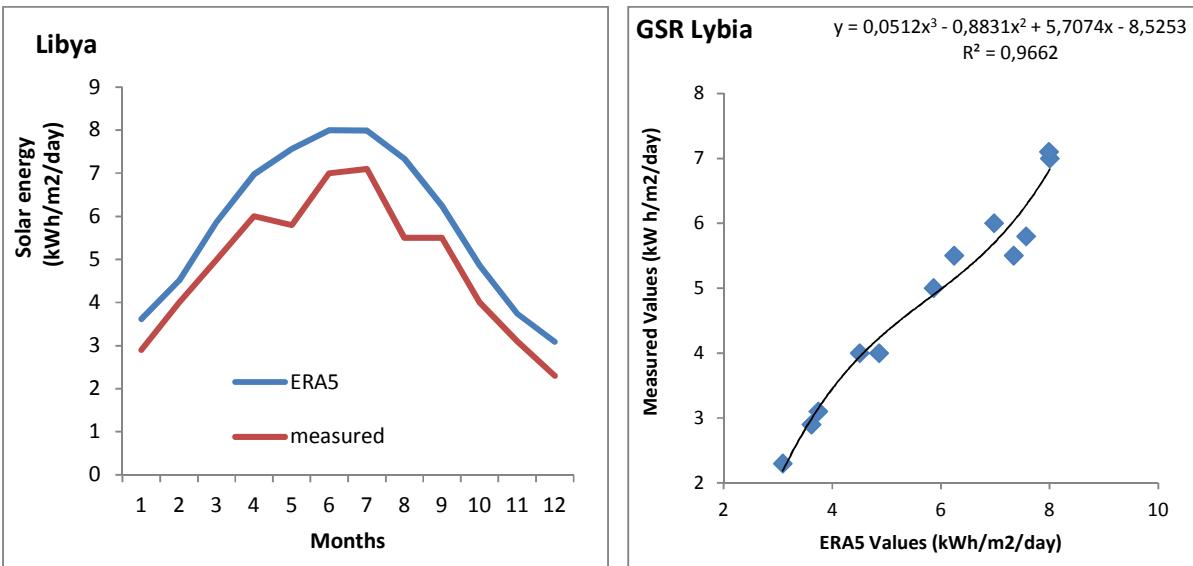


Fig. 11: Scatter plot between Measured and Reanalysis data ERA5 of GSR for Algeria in the present study.

**Table 1: The statistical results of MBE, RMSE, MPE, R², and t-Test in the present research**

Country		J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Egypt	MBE	6.58	-5.43	7.21	8.55	-4.38	9.42	5.94	-2.57	7.35	6.87	-3.59	-6.58
	RMSE	13.26	11.43	9.57	7.84	9.46	8.28	7.52	10.54	14.58	8.97	6.59	9.74
	MAP %	6.57	4.59	8.39	9.45	7.36	8.35	4.89	9.58	8.27	5.98	4.89	7.35
	R ²	0.896	0.954	0.938	0.876	0.896	0.925	0.942	0.938	0.874	0.958	0.968	0.937
	t-Test	2.35	4.35	3.45	1.89	5.32	4.32	4.32	5.36	2.68	3.48	2.69	4.37
Libya	MBE	5.39	4.32	9.21	-4.56	5.34	-8.53	-6.34	5.78	6.56	-8.27	4.53	5.47
	RMSE	10.5	9.71	12.54	5.68	11.42	4.54	6.56	9.87	7.85	10.64	9.56	7.57
	MAP %	4.65	6.49	4.65	7.35	5.36	6.58	7.32	7.35	5.32	7.36	5.36	4.89
	R ²	0.925	0.924	0.896	0.954	0.915	0.947	0.963	0.924	0.947	0.942	0.925	0.945
	t-Test	3.11	5.23	4.59	2.65	6.23	3.45	4.89	4.32	3.25	2.89	3.58	5.24
Morocco	MBE	-4.25	5.26	7.28	-3.48	7.24	6.25	-3.25	4.74	7.23	3.56	5.48	-7.62
	RMSE	9.57	7.83	8.32	7.58	9.64	7.58	5.49	6.53	5.58	8.74	7.82	5.77
	MAP %	3.45	5.45	4.23	5.24	7.35	8.25	5.78	4.89	6.35	4.89	3.58	3.11
	R ²	0.896	0.954	0.947	0.915	0.965	0.927	0.897	0.899	0.878	0.915	0.945	0.965
	t-Test	5.32	6.32	3.45	4.25	3.12	3.98	6.34	5.32	5.36	3.45	4.23	3.27
Tunis	MBE	6.25	-3.87	5.32	4.57	-6.25	4.32	-4.35	-3.45	5.35	-4.25	3.57	6.35
	RMSE	7.54	5.82	7.36	6.29	4.93	5.61	6.75	4.94	3.86	9.47	5.73	3.84
	MAP %	4.89	6.35	3.47	7.25	5.78	6.35	4.87	5.87	5.44	3.78	4.78	6.87
	R ²	0.954	0.927	0.924	0.937	0.897	0.947	0.876	0.957	0.925	0.945	0.924	0.927
	t-Test	3.89	5.11	4.97	4.57	5.68	3.74	5.89	3.65	4.25	3.87	5.32	4.37
Alger	MBE	7.35	4.35	-3.87	-5.78	5.47	7.32	-6.35	-4.32	-3.58	5.27	-4.39	5.32
	RMSE	6.35	4.32	5.38	4.28	3.45	3.87	5.47	3.65	4.87	8.32	4.37	5.27
	MAP %	3.65	5.24	4.35	6.35	4.89	5.28	6.32	3.95	4.29	4.56	3.27	5.18
	R ²	0.927	0.968	0.947	0.915	0.885	0.927	0.932	0.942	0.939	0.947	0.918	0.937
	t-Test	5.32	3.24	3.87	5.36	6.38	4.11	4.35	3.48	6.32	5.32	4.39	3.98

Fig. 14 shows the monthly average of the selected cities over Africa for global solar radiation by ERA5 compared with the measured data along the period 2011-2020. These measured data are used to evaluate the reanalysis data from ECMWF ERA5 datasets, the result of the comparison between measured data and reanalysis showed that the best fitting between ERA5 and measured data was found in two stations Aswan and Nouakchott. While in other, stations were found to overestimate as shown in Alger and Tripoli.

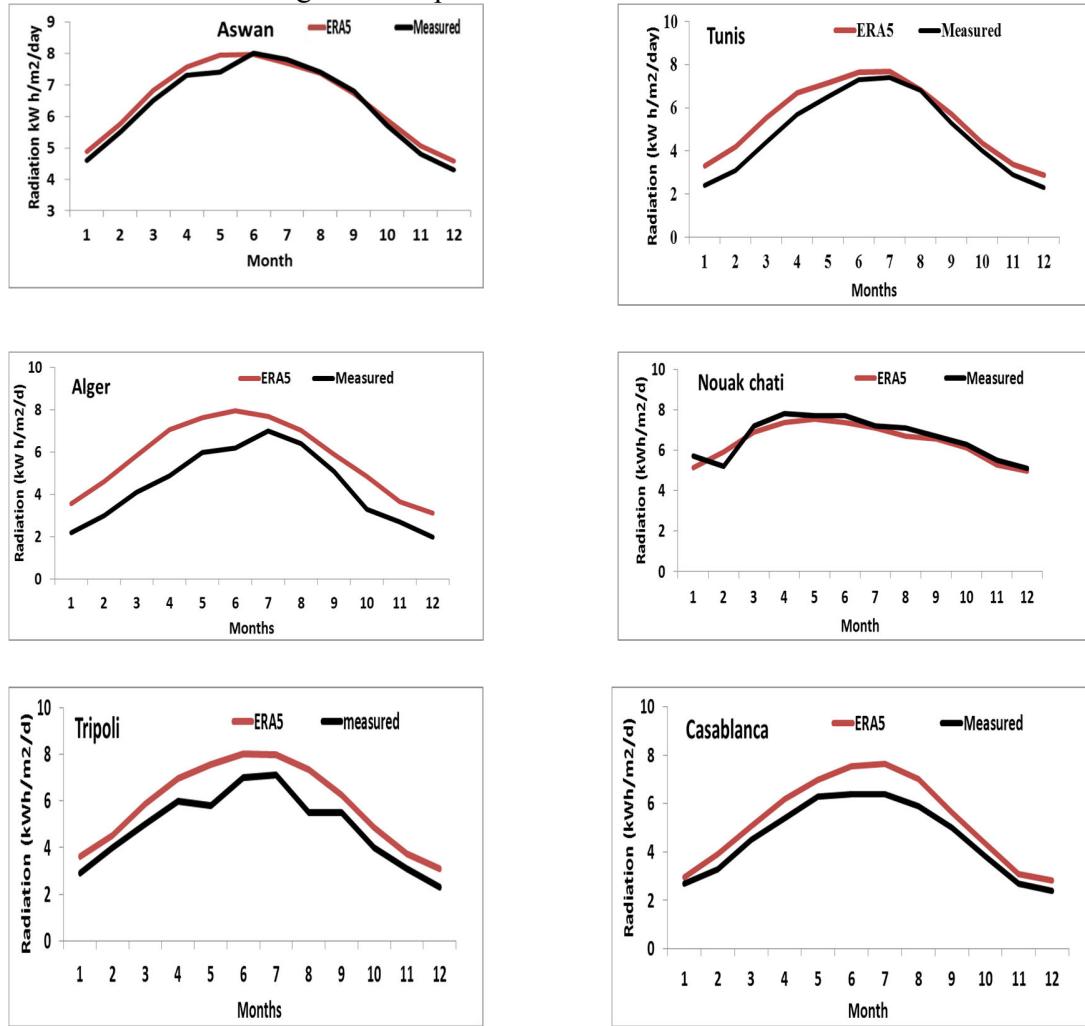


Fig. 14: Monthly average of the selected cities over Africa for Global Solar Radiation

The seasonal variations of solar energy in most latitudes and longitude in North Africa in the present study are clear in Fig. 15. From this figure, we indicate that the seasonal variations of solar energy depend on latitude and longitude and the methodology adopted. This study also affirms latitude as the dominant locational factor. In addition, the domain of application in the study is the largest so far. Finally, the optimal performance in respect of estimating global solar radiation for any practical application.

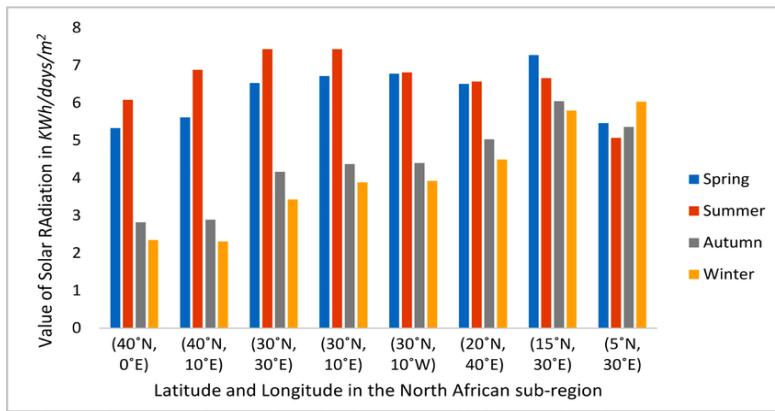


Fig. 15: The seasonal variations of solar energy in most latitude and longitude in North Africa in the present study.

Renewable energy consumption in North Africa remains largely untapped relative to its potential clear in Fig. 16 [34]. Renewable energy sources made up 4.3% of total energy consumption in 2018, which is roughly two percentage points less than the levels seen in 2008 (6.0%). The drop is the result of rising transportation demand in Algeria and Egypt, as well as reducing traditional biomass use in Morocco. The primary uses of traditional biomass, the region's major source of renewable energy, in the domestic sector are for cooking and heating. Its usage, though, has been linked to detrimental effects on both human health and the environment. Hydropower is the second-largest source of renewable energy in the area, followed by contemporary bioenergy. Recent years have seen a tremendous increase in wind, solar thermal and solar PV, particularly in Egypt, Morocco, and Algeria. 2018 saw a regional share of contemporary renewable energy, excluding traditional biomass use, of 1.9%; however, country-level levels range widely, from less than 1% in Algeria to 7.6% in Morocco. The region's net energy importers, Morocco and Egypt (and to a lesser degree, Tunisia), have the greatest shares, where energy diversification away from fossil fuel imports has been one policy push for renewable deployment. These nations account for almost 96% of the region's use of renewable energy in total, but only 66% of the total energy demand. Electricity in North Africa has the largest percentage of modern renewable energy sources, with 6.9% of the total supply in 2018. Modern renewables only made up 1.4% and 0.03% of the heating and transportation sectors, respectively, where penetration has been slower. Fig. 17 depicts the capability of solar energy in a number of different African nations in the year 202. As of 2020, South Africa's solar energy capacity, which was close to six gigawatts, was the highest in all of Africa. This was equivalent to nearly 60% of Africa's annual solar energy capacity. At 1.7 gigawatts, Egypt had the second-largest capacity. Morocco came in second with a solar energy capacity of 734 megawatts [35]. Table 2 makes it evident that PV has been active in countries in North Africa over the past three decades. Egypt provides more than 80% of the region's hydropower, which is followed by wind energy, which is mostly produced in Morocco, Egypt, and Tunisia. Because production is dependent on precipitation amounts, hydropower generation fluctuates from year to year. As a result, due to changes in rainfall in the area, hydropower generation over the past 10 years has ranged between 15 TWh and 16 TWh. The third-largest source in the region is solar PV, which is almost exclusively used at utility scale and is the only technology that is used in every nation, as opposed to solar thermal, which is used only in Morocco

and is the fourth-largest source. The smallest source, bioenergy, is exclusively fun in Egypt (Fig. 18). Due to the tremendous growth of wind, solar PV, and solar thermal over the past 10 years, the amount of renewable electricity produced in North Africa has increased by more than 40%. Morocco accounts for three-quarters of the region's growth, which is fuel by regulations that encourage private investments such corporate power purchase agreements and independent power producer (IPP) competitive auctions (PPAs). The biggest percentage of renewable energy in the area is use to generate over 20% of the power used in Morocco. The rest of the growth is from Egypt, Algeria, and Tunisia driven by a mix of procurement methods such as feed-in tariffs (FiTs); competitive auctions; unsolicited bilateral contracts; utility engineering, procurement, and construction contracts. However, despite the rapid increases in solar and wind generation, the overall share of renewable electricity declined from 7.3% in 2008 to 6.7% in 2018 because total power demand in North Africa has grown faster than renewables. In addition, lower hydropower output from less rainfall has also contributed to this decline [36].

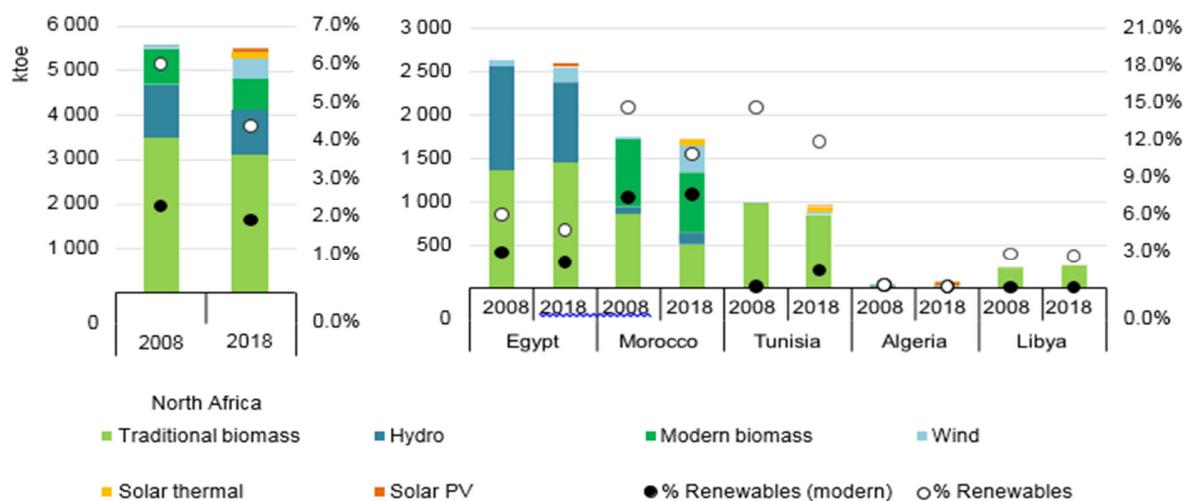


Fig. 16: Renewable energy consumption in North Africa [34].

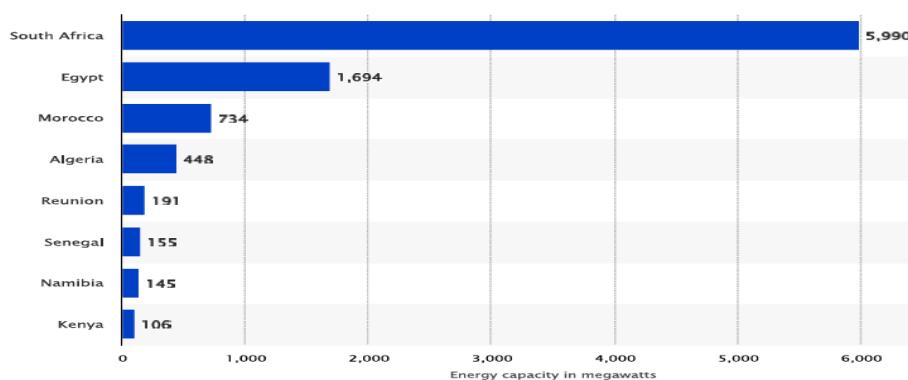
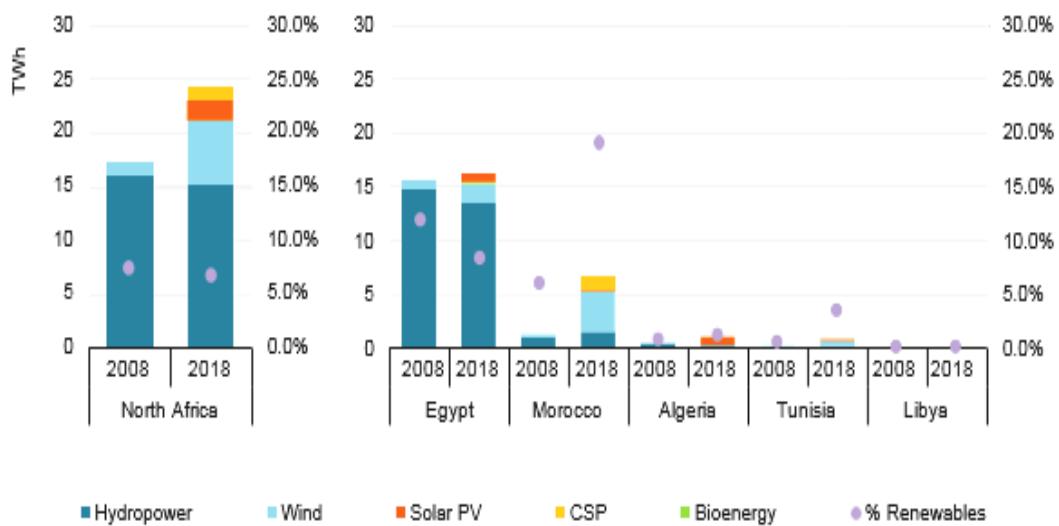


Fig. 17: Solar energy capacity in selected countries in Africa in 2020 (in megawatts) [35]

Table 2: The average values of PV out in North Africa during last 3 decades (*in megawatts*).

Country	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year
Egypt	138	154	206	228	225	205	231	213	195	161	135	128	2219
Morocco	124	138	193	217	240	235	226	206	179	155	122	113	2148
Tunis	136	141	188	205	226	231	225	201	174	151	129	118	2155
Libya	122	145	171	202	218	227	216	199	179	149	131	114	2169
Algeria	145	163	225	254	249	253	238	219	185	175	141	132	2254

**Fig. 18: Renewable electricity in 2008 and 2018 in North Africa and country [36].**

6. Conclusion

The five countries that span North Africa have significantly different circumstances that influence their energy transitions pathways. The region includes large hydrocarbon producers and exporters (Algeria, Egypt and Libya), as well as countries that are heavily dependent on imports to meet domestic energy demand (Egypt, Morocco and Tunisia). The opportunities for improvement are not limited to increasing the sectors in which electricity can be consumed and replacing more polluting fuels, but also the way they are produced. North Africa's generation mix is marked by its reliance on fossil fuels. At 4.6% of the overall generation mix, renewables still play a small role that falls far below the global average of 25%. This is not commensurate with the available resources, as North Africa has some of the most favourable sites in the world for solar irradiance as well as significant wind potential in the coastal areas [24]. North Africa has tremendous potential for increased renewables deployment, which could reduce dependence on imported fuels in Morocco and Tunisia while freeing up additional resources for export in Algeria. All five countries have long-term targets for increasing renewable electricity capacity. By 2030,

Algeria targets 22 gigawatts (GW), Morocco 10 GW, Libya 4.6 GW and Tunisia 2.8 GW, while Egypt targets 54 GW by 2035. Generally, in the present research we can put the important results as follows:

1. With notable regional inequalities, only 2% of worldwide investments in renewable energy during the past two decades have been invested in Africa.
2. North Africa only accounts for 3% of all renewable energy jobs globally.
3. In Sub-Saharan Africa, the electrification rate remained constant in 2019 at 46%, leaving 906 million people without access to clean cooking technologies and fuels.
4. However, the continent has great potential.
5. Wind, solar, hydro, and geothermal energy resources are abundant in North Africa, and the cost of renewable energy sources is steadily declining.
6. Mineral resources found in abundance in central and North Africa are necessary for the manufacture of electric batteries, wind turbines, and other low-carbon technology.
7. The past 10 years have seen advancement:
8. The use of renewable energy has increased during the past 10 years, with despite the challenging move away from carbon-intensive energy sources; the energy transition has enormous possibilities for Africa when coupled with a suitable policy basket.
9. The energy transition under IRENA's 1.5°C Scenario anticipates, on average up to 2050, 6.4% greater GDP, 3.5% more jobs across the economy, and a 25.4% higher welfare index than that realized under existing plans.

Finally, North African countries are among the most vulnerable regions to the potential impacts of climate change. The increasing impact of climate change shows the need to build up a reliable energy mix and improve the resilience of existing and new energy systems. Adequate investment in resilient energy systems and infrastructure for the region will be vital. Clean energy transitions in North Africa need to incorporate planning and investment decisions that ensure their energy systems are climate resilient and secure.

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Software-defined Networks in Utility Power Networks

Ava Salmanpour
ICT expert
Monenco consulting company
Tehran, Iran
Salmanpour.Ava@monencogroup.com

Elahe Hamzeil
ICT expert
Monenco consulting company
Tehran, Iran
Hamzeh.Elahe@monencogroup.com

Hanieh Saeedi
ICT expert
Monenco consulting company
Tehran, Iran
Saeedi.Hanieh@monencogroup.com

Shima Alimohammadi
Project Manager
Monenco consulting company
Tehran, Iran
Alimohammadi.Shima@monencogroup.com

Mohammad Asadian
Director of Communication and Information
Technology Group
Monenco consulting company
Tehran, Iran
Asadian.Mohammad@monencogroup.com

Payam Rouhi
ICT expert
Monenco consulting company
Tehran, Iran
Rouhi.payam@monencogroup.com

Siamak Hossein Khalaj
Deputy of Communications, Information
Technology and Dispatching
Monenco consulting company
Tehran, Iran
Khalaj.Siamak@monencogroup.com

Abstract— Software-defined network (SDN) is a network architecture designed to control network using software application in a central manner. This ability enables remote control of the whole network regardless of the network technology. In fact, in this architecture network intelligence is separated from physical infrastructure, it means that required network components can be implemented virtually using software applications. Today, power networks are characterized by a high range of complexity with a large number of intelligent devices, processing both huge amounts of data and important information. Therefore, reliable and secure communication networks are required. SDNs are the best choice to meet this issue. In this paper, SDN networks capabilities and characteristics will be reviewed and different basic controllers will be compared. The importance of using SDNs to escalate efficiency and reliability in utility power networks is going to be discussed and the comparison between the SDN-based power networks and traditional networks will be explained.

Keywords—Software-defined network, SDNs, utility network, open flow, communication, gas and electricity, controller.

I. INTRODUCTION

Software-Defined Networking (SDN) is an approach in computer networks that enables network administrators to manage network services through higher-level abstraction. This is done by separating the system that decides how to route traffic (the control plane) from the underlying system that is tasked with routing packets to the chosen destination (the data plane) (Fig. 1).

Today, with the advancement of technology in the field of telecommunications, SDN technology has become a hot topic and has created competition between companies.

SDN enables programming of the network behavior in a centrally controlled manner through software applications using open APIs (Application Programming Interfaces). Manufacturing completely open network devices has never come true in the real-world applications and still there exists many challenges in network establishment. As SDN uses Open Protocols to access network components, fully open networking is feasible with this technology.

SDN enables continuous network management, which may be made up of complex technology components [1]-[3].

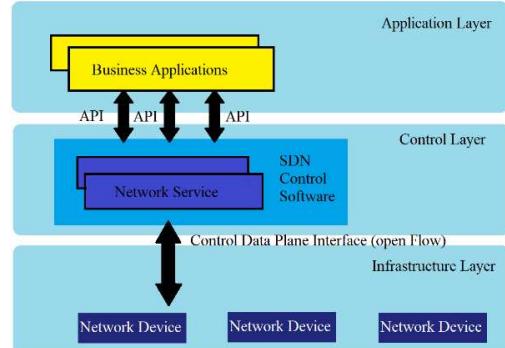


Fig. 1. SDN layer

SDN has been around since 1996 to create user management for sending and receiving. Two factors are needed to realize the idea of SDN. First, there must be a common logic architecture between all switches, routers and other equipment. Second, a secure protocol between SDN and network equipment is required. Various protocols have been proposed for this concept, including Ipsilon 1996 and IETF 2000, Ethan 2007 and Open Flow 2008. Both of these requirements have been met by Open Flow [4].

There have been many surveys and overviews of SDN in recent years in different papers. W. Xia et al. explained SDN features and its layers. Multi-controller is briefly mentioned and some methods are explained to enhance the control layer performance [5]. A. Nunes and et al. [6] presents multi-controllers, by providing the difference between centralized and distributed controllers. M. Buranova, and A. Muthanna [7] presents a specific survey about the control plane. In this paper, control architecture, performance, scalability, placement, interface and security aspects have been considered. Researchers have developed systems to co-simulate the power and network components of the smart grids [8]-[14]. Reference [15] surveys the existing technologies and motivations for co-simulation. S. Ciraci and

his coworkers work on synchronization algorithms for co-simulation of power grids and communication networks [8]. In [9], the authors studied a framework for power systems and communication networks co-simulation. Christian Dufour and Jean Bélanger discussed the various aspects involving the research and development of smart grids. They explained how such challenges are addressed using real-time simulation technologies in different laboratories around the world [10]. T. Godfrey and et. al modeled Smart Grid Applications using co-simulation. They used their results in an open-source event-driven simulator to determine the impact on the electrical power system [11]. In [12], K. Hopkinson and his colleague worked on a platform for agent-based electric power and communication simulation built from commercial off-the-shelf components. Lin et al. [13] proposed a co-simulation framework for power systems and communication networks, using a global event-driven mechanism. The accuracy is tunable based on the time-scale requirements of the phenomena being studied. This co-simulation can improve the practical investigation of smart grids and evaluate wide area measurement and control schemes. As a case study, a communication-based backup distance relay protection scheme is co-simulated and validated on this co-simulation framework. Mets and et.al classified the different simulators according to target use cases, simulation model level of detail, and architecture [14]. Montenegro and Hernandez [15] presented the real time analytical simulation of the IEEE 13 Nodes system with the aim of evaluating the performance of the developed tool.

This paper is organized as follows: SDN Technology and its architecture will be reviewed in section II. In section III, SDN applications and its implementation in utility power networks will be provided. And finally, in section IV, the conclusion will be discussed.

II. SDN TECHNOLOGY

Traditionally, Ethernet switches have a processing unit as the control plane and another part as the data plane. Each network equipment has an independent data processing and packet sending system. Fig. 2. shows the traditional architecture of the network equipment. Configuring the network device, actually means interacting with the control plane. Processes relating to data transfer include Switching, Routing, QOS, Access Control List, etc.

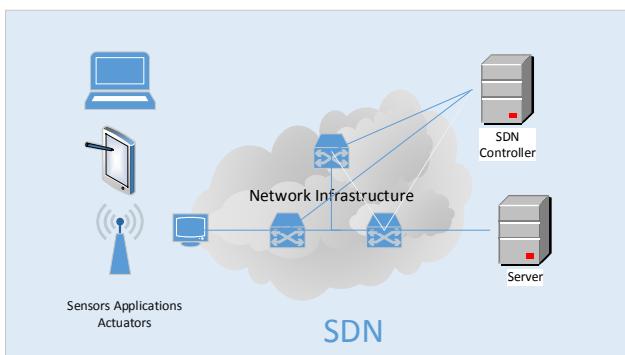


Fig. 2. SDN Technology

The main processor of the device and optimized software (IOS) are incorporated in the Control plane. One of the main

features of network hardware is performing the required processes in the shortest time, which is actually one of the competitive challenges among network equipment manufacturers, providing hardware equipment and optimal methods to perform such processes quickly and efficiently. Looking at the network equipment in the last 10 years, we can see the reduction of time required to send data packets (Switching Latency) and the increase in the volume of forwarding traffic (Forwarding Throughput). For example, the Cisco Catalyst 2960 series switches have been upgraded from 32 Gbps to more than 200 Gbps, and this trend continues (Fig. 3).

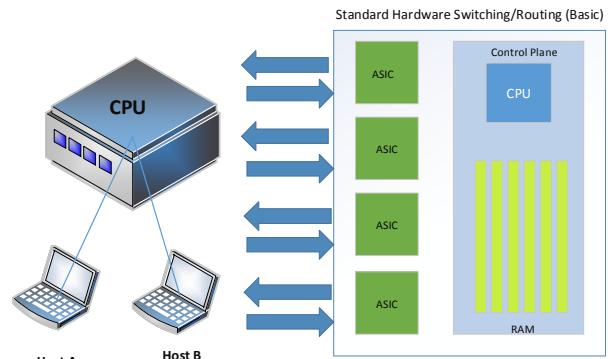


Fig. 3. Hardware switching/Routing

The SDN architecture focuses on four main areas (Fig. 4):

- 1- Separating the control layer from the data.
- 2-Centralized controller and comprehensive view of the network.
- 3-Having an open user interface between the controller and the data layer.
- 4-Ability to program the network with off-grid applications.

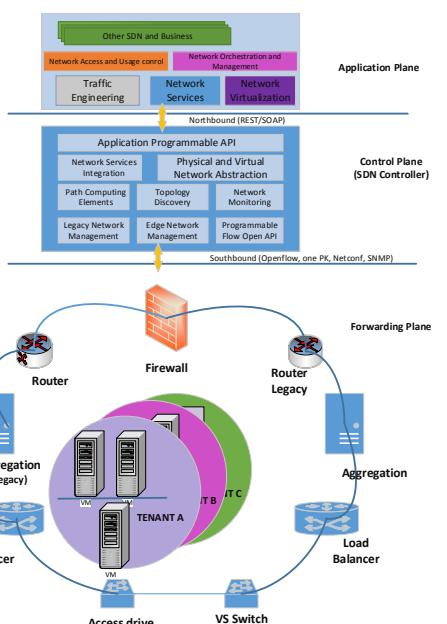


Fig. 4. The SDN architecture focuses on four main areas

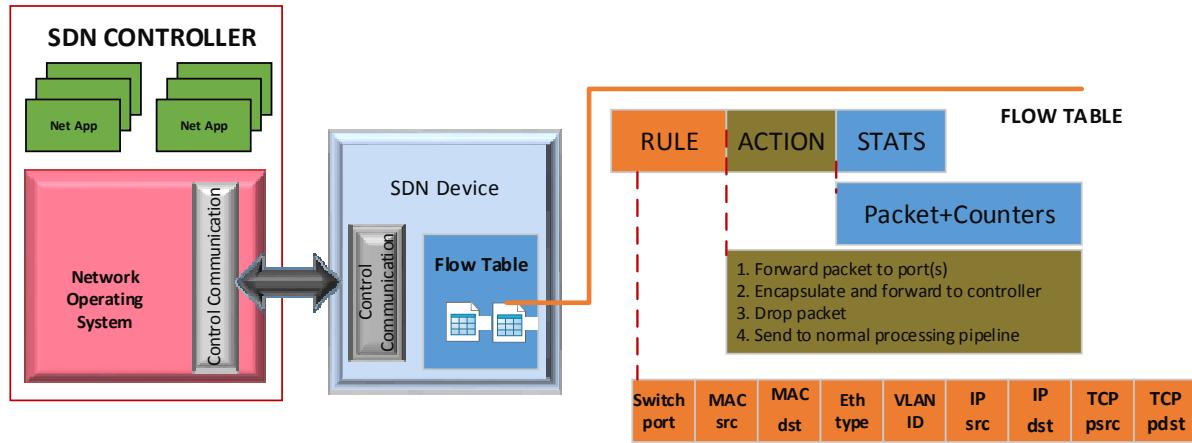


Fig. 5. Navigation equipment - SDN switches

This high-end model of Open Flow is currently used in the construction and implementation of many SDN devices.

In an Open Flow device, the behavior of a packet is determined by a series of consecutive flow tables. When a packet is entered, a search process starts from the first table and continues until it is matched or a rule for that packet is definitely found. As shown in Fig. 5, a flow rule can be defined in many different ways. If no default rules are installed on the switch, then the package will be discarded. Typically, though, a default rule will be installed on the switch that instructs the switch to send all incoming packets to the controller (or to a typical non-Open Flow pipeline on the switch). In hybrid switches using normal pipeline, this feature allows packets to be routed by default without using the Open Flow protocol. Once an adaptation has occurred, certain actions must be taken for that flow.

Actions are as follows:

- Packet routing to designated output ports;
- Encapsulate and then direct the package to the controller;
- Drop;
- Send it to Normal pipeline;
- Sending it to the next stream table or to specific tables, such as Group Tables or Metering Tables.

SDN Controller: The controller is like a network operating system that controls the hardware as well as facilitates automatic network management. This operating system provides a centralized and integrated programmable interface for the entire network. Just as the operating system on a computer makes it possible for applications to read and write, so does the network operating system provide the ability to view and control the network. The controller, then, does not perform network management alone, but merely as a programmable interface that enables network management for user software.

A. Open flow protocol

The Open Flow is one of the best standards offered by ONF¹. Open Flow is a protocol designed for the network controller

and its data portion. It is one of the most famous and popular intermediaries in the evolution of SDN networks. In order to have Open Networking capability, switches must be designed in compliance with Open Flow Protocol [16].

The Open Flow standard is independent of the manufacturer. It is the interface between the data and the control part of the network. In fact, it is a protocol and standard written in C programming language. The switch operates at the network data layer level and can support the Open Flow Protocol. In addition to being used on physical devices, the Open Flow protocol can be deployed on virtual machines such as Open hypervisor, which can create a virtual switch that can use this protocol. With the help of hypervisor-based networks, equipment such as routers and switches can be implemented physically or virtually.

The most popular equipment based on the Open Flow protocol is IBM's Gigabit Ethernet Open Flow switches. In addition, Hp offers fully powerful switches that can support the Open Flow protocol and can be used on SDN networks.

B. SDN controllers

An SDN controller manages flow control for improved network management and application performance. The SDN controller platform typically runs on a server and uses protocols to tell switches where to send packets.

Many SDN controllers exist, but here the most popular Open Source SDN controllers in industry and academia will be compared, including: The Open Network Operating System (ONOS), Open Daylight (ODL), Open Kilda, Ryu, and Floodlight.

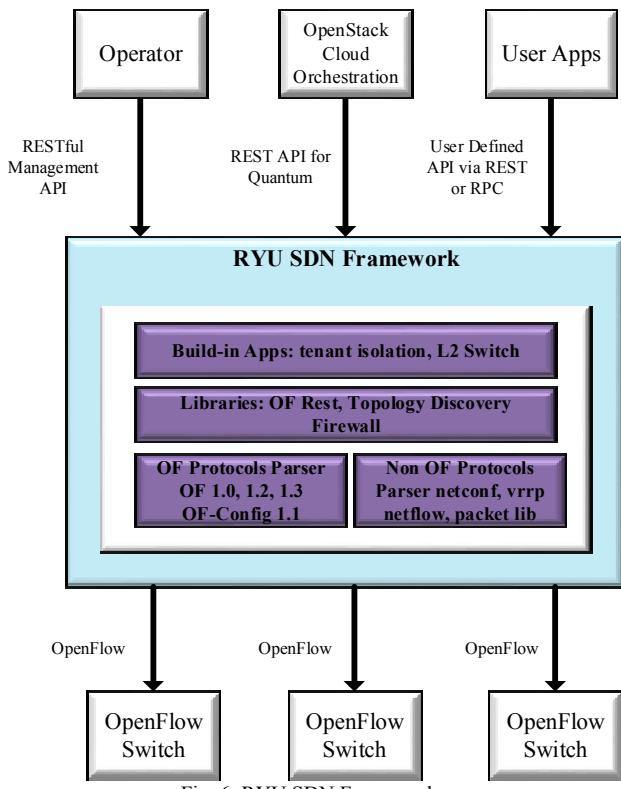
Open Network Operating System (ONOS): The Open Network Operating System is a leading open source SDN controller for building next-generation SDN/NFV solutions based on the Linux Foundation project. Due to a very rich SBI support to Open flow, P4, NETCONF, TL1, SNMP, BGP, RESTCONF and PCEP protocols, ONOS places itself as one of the controllers with a wider range of SBI coverage.

OpenDaylight: improves SDN by giving features and protocols that hold up to the industry standard. Under the Linux Foundation, OpenDaylight consists of support for the Open Flow protocol, however, it can also support other open SDN standards.

¹ Open Flow Foundation

OpenKilda: solves the problem of implementing a distributed SDN control plane with a network that spans the globe, furthermore it provides a scalable SDN control and data plane and end-to-end flow telemetry, therefore solves the latency problem.

Ryu: is an Open Source SDN Controller aimed to reduce the traffic and increases the flexibility of the network. Ryu, a good choice for small businesses and research application, provides several components with full program interfaces that create new network management and control applications with ease conveniently (Fig. 6).



Floodlight is an Open Flow controller with the following features:

- Enterprise-class
- Apache-licensed
- Java-based

Floodlight controller design is high performance and is well scalable in high component networks. The Floodlight controller is based on another controller called Beacon. The Java programming language was chosen because it strikes the right balance between performance and user-friendliness. It is also portable, meaning it runs on a variety of operating systems. In addition, Beacon and Floodlight have good, simple, and user-friendly programming interfaces that come with useful applications, including (Fig. 7):

- Device Manager: Tracks devices seen on the network.

This tracking includes items such as their address information, the last date, the last switch and port where they were viewed.

- Topology: Detects links between Open Flow switches.

- Routing: Provides the shortest layer 2 routing between network devices.
- Web: Provides a web-based user interface.

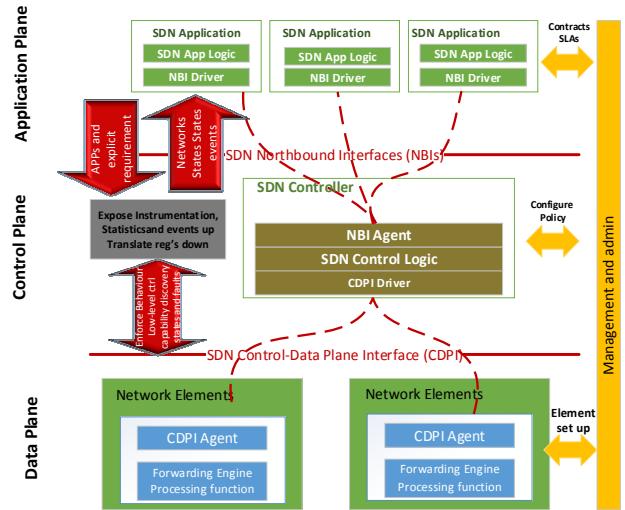


Fig. 7. Floodlight controller

One of the advantages of Beacon and Floodlight is the ability to start or end applications during the control process. This means that they can be added or removed without the need to deactivate the controller. The applications are completely multi-threaded and have blocking (Shared Queue) and non-blocking (Run-to-completion) algorithms for reading Open Flow messages. It has the best performance.

Some of the limitations of traditional architecture are as follows:

1. Lack of agility and automation of service implementation procedures in all network equipment: For example, ACL or QoS configuration must be repeated and performed on each network equipment, and this process is time consuming and prone to error. In fact, the required configuration cannot be done once and extended to all network equipment.

2. Limited processing and heterogeneous scalability based on network service needs: The performance of network devices is significantly reduced if you run services such as PBR, QoS, Calculation Routing, Traffic Engineering, etc. In traditional architecture, the network layer is considered in specific layers, and as a result, the corresponding processing load in that layer of the network increases exponentially, and therefore a traffic jam occurs. Attempts to increase processing power in order to overcome this limitation have not been fruitful.

3. The impossibility of centralized management of equipment performs data transfer on the network. The reason lies in the lack of a complete and accurate view of the logical network connection. Neither creating a comprehensive and integrated solution to configure network equipment involved in the data transfer process nor instantaneous data monitoring was possible in the traditional architecture.

4. Impossibility of creating overlapping networks with the ability to completely separate information technology services hosted in the data centers. This arises the need for logical separation of customers of such services. In traditional architecture, this is possible by using virtual networks

(VLANs) and applying security controls. Due to the inherent limitations of such protocols, quantitative and qualitative scalability face many limitations. Therefore, the impossibility of creating overlapping networks or multi-Tenancy with the possibility of providing service is another weakness of traditional network architecture.

5. Impossibility of managing and controlling the generated traffic from source to destination in the virtualization infrastructure completely due to the lack of logical connection between the virtual network infrastructure and the physical network platform. It is not possible to apply control policies to the data packet in the virtual platform. It goes to the physical network platform.

C. utility network

A utility network manages utility and telecom networks, providing a comprehensive framework for the modeling of utility systems such as electricity, gas, water, wastewater, and telecommunications. This network models all of the features to make up system components such as wires, pipes, valves, zones, devices, and circuits and builds real-world behavior into the network features (Fig. 8).

In a utility network, the following tasks can be accomplished:

- Create and edit features and objects that model every type of utility equipment.
- Trace how resources, such as gas, water, and electricity, flow through the network.
- Discover how features and objects in the network are connected.
- View the current configuration of dynamic devices.
- How the network is affected by real-world events such as storms, outages, or equipment failure.

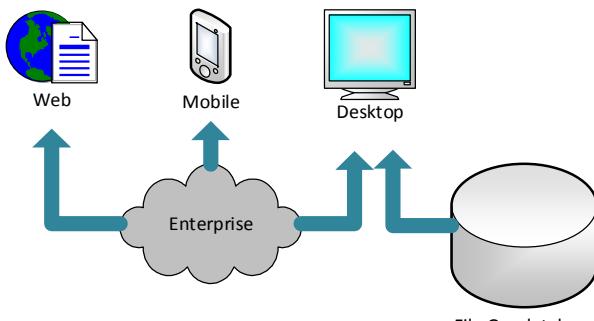


Fig. 8. Utility network

III. SDN IN UTILITY POWER NETWORKS

Connectivity services used in utilities and energy companies are leased or produced by multiple vendors with different product life cycles and potential incompatibilities. Therefore, Utilities and energy companies have to deal with the complicated task of maintenance and upgrade of equipment from different manufacturers. Applications and services that run on these networks differ from regular carrier networks. Oil and gas, in particular, have three levels of applications: upstream, midstream, and downstream [8].

Utilities and energy companies own and operate multiple networks, as shown in Fig. 9, covering large areas and requiring complex management.

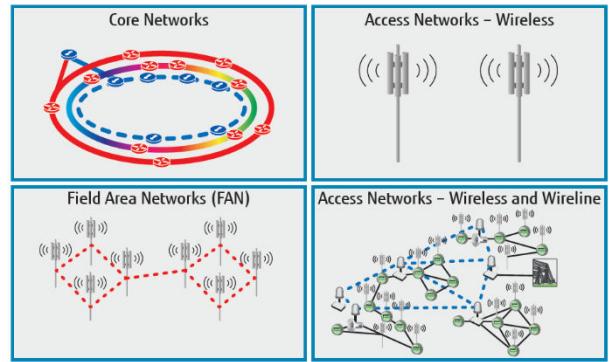


Fig. 9. Typical utility communications networks

Keep upstream applications, which usually are mission-critical emergency response applications, near well-heads or entry points in the field, on premises is so advantageous. On the other hand, midstream applications have a lower priority compared to upstream applications. These applications relate to maintenance of the energy distribution networks and/or vehicle fleets. Downstream applications, the lowest priority applications, are the retail apps facing end-customers, and internal training apps. All these applications/services need flexible bandwidth for efficient use of network resources.

One of the challenges for the utilities and energy sector is management, maintenance, and migration of the network and its software, which are very labor-intensive due to high emphasis on manual configurations, even for a single-domain network, let alone a multiple-domain network [8].

The overall topology changes constantly during the process of adopting multiple different networks with a cocktail of technologies in the various domains (WAN, AN, FAN, etc.). Software upgrades are also challenging. In the security area, it is crucial to meet and follow frequent changes since regulatory compliance is changing all the time as a moving target. These days in every business sector, mergers and acquisitions are also more frequent and the energy sector is no exception. Therefore, they frequently face the task of merging multiple networks or seamlessly integrating one into the other.

As mentioned prior in this study, software defined networking (SDN) is an emerging network technology that separates the data plane from the control plane. The advantage of this technology is the ability to have global control and view over the network and program the network switches to provide functions. Complex network functions are created by adjusting paths and flows in real time thanks to SDN networks. This technology boosts security issues and increases performance in many networks such as data centers, and even in energy infrastructure [17].

Due to ever-increasing user demand for electricity, the current power grids have to be upgraded into the more reliable smart grid (SG). Two-way communication, demand side management, and real time pricing are key features for these networks.

Here we can classify the use of SDN in utility networks in several areas as follows [18]-[20]:

- 1) Incorporating SDN-based SGC in Utility M2M Applications
- 2) Incorporating SDN-based SGC in Substation Automation and Monitoring

3) Integrating SDN-based SGC with Cloud and IoT based Applications

The comparison of traditional SG and SDN-based SGC is summarized in Table I. The SDN controller, by using the programmability feature, would increases reliability situations and decreases delay time. Different SG components follow different standards and protocols and SDN controllers should be able to cope with all such diverse communication systems.

TABLE I COMPARISON BETWEEN SMART GRID AND SDN-BASED SGC

SDN Based SGC [26]-[29]	Smart Grid [21]-[25]
Easily programmable	not highly programmable
Easy, automatic, and faster	Complex, time consuming, and Manual
Protocol independence	Not truly protocol independent
Need more effort in security and privacy	Several security and privacy schemes are proposed
Need more simulation tools	Simulation Tools & Testbeds are available
Resilience against failures	Not too much resilient
Low of work is done on SG standardization	Low of work is done on SG standardization

IV. CONCLUSION

This paper addressed the issues of security, reliability, and efficiency in utility power networks based on SDN technology. Utility networks are a kind of network represents companies operating in the field of gas distribution value chain, meter manufacturers and metering services companies, data and smart systems providers, professional service organizations as well as consultancy group services. This study aimed to clarify how SDN technology can overcome challenges of the traditional network architecture. Moreover, the main characteristics of different SDN controllers were investigated. Results show that Networks based on SDN Technology proved to be faster, more efficient, highly programmable, and more resilient compared to the networks established on traditional architectures. The SDN technology will be a wise alternative for the utility network, Considering the emerging requirements of a modern utility grid. In the end, this paper presents advantages of SDN-based SGC over typical Smart Grids. It is concluded that networks based on SDN technology are more reliable and efficient; that is why with the advancement of technology in recent years, SDN-based networks have overtaken many different industries.

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Experimental Study of Hydrothermal Properties of Cool Pavements to Mitigate Urban Heat Islands

Y Wardeh^{1,2}, E Kinab², P Rahme², G Escadeillas¹, S Ginestet¹

¹ LMDC, Université de Toulouse, INSA, UPS, France

² Lebanese University, Beirut, Lebanon

Abstract: Urban heat islands designate a local phenomenon that appears in high density cities. This results in a rise of ambient temperature in the urban area compared to the neighboring rural area. Solar radiation plays an important role in this phenomenon, since it is partially absorbed by the materials, especially roads and parking lots. Cool pavements constitute an innovative and promising technique to mitigate urban heat islands. The cool pavements studied in this work, allow to limit the increase of the surface temperature, thanks to evaporation of the water conducted through capillary pores, from the humidified base to the surface exposed to solar radiation. However, the performance or the cooling capacity of a pavement sometimes remained difficult to characterize. In this work, a new definition of the cooling capacity of a pavement is presented, and a correlation between the latter and the hydrothermal properties of cool pavements is revealed. Firstly, several porous concrete pavements were characterized through their hydrothermal properties which can be related to the cooling effect, such as albedo, thermal conductivity, water absorption, etc. Secondly, these pavements initially saturated and continuously supplied with water through their bases, were exposed to external solar radiation during three sunny summer days, and their surface temperatures were measured. For draining pavements, a strong second-degree polynomial correlation ($R^2 = 0.945$) was found between the cooling capacity and the term which reflects the interconnection of capillary water to the surface. Moreover, it was noticed that the cooling capacity reaches its maximum for an optimal range of capillary pores for which the capillary rise is stronger than gravity. For non-draining pavements, a good negative linear correlation ($R^2 = 0.828$) was obtained between the cooling capacity and the term which expresses the ability to heat the capillary water by the energy stored far from the surface, and therefore the dominance of the evaporation process by diffusion. The latest tests showed that this process is however likely to be disturbed by the material resistance to the water vapor diffusion.

Keywords: urban heat islands, cool pavement, cooling capacity, hydrothermal properties, evaporation.

Synthesis and Characterization of Crosslinked Macroporous Silanized Magnetic Polymer Nanocomposites Based on Glycidyl Methacrylate

Ljiljana Suručić¹, Aleksandra Nastasović², Bojana Marković², Tamara Tadić², Antonije Onja³

¹ Faculty of Medicine, University of Banja Luka, Save Mrkalja 14, 78000 Banja Luka, Republic of Srpska, B&H

² University of Belgrade - Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

³ Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

Abstract

Numerous studies on the sorption of heavy metals have utilized aminofunctionalized cross-linked copolymers PGMA composed of glycidyl methacrylate and ethylene glycol dimethacrylate. They serve as excellent matrices for chelated sorbents due to their physical and chemical properties. PGMA are synthesized using an *in situ* suspension copolymerization method that yields spherical porous particles whose diameter and degree of porosity (internal structure) are directly controlled by synthesis parameters. Researchers have extensively studied the properties of macroporous PGMA particles to date. The degree of porosity, or the internal structure (the presence, size, and arrangement of pores), are closely correlated to synthesis conditions, particularly the type and proportion of the inert component (porogen) and the crosslinker in the monomeric phase and to a lesser extent on the polymer treatment. Previous investigations showed that this polymer properties have a significant impact on sorption and that increasing the inner surface of the particles makes them more sorption-effective. In this study, two samples of magnetic polymer nanocomposite based on glycidylmethacrylate (GMA) and ethylene glycol dimethacrylate (EGDMA) were synthesized by suspension copolymerization *in situ* in the presence of magnetite nanoparticles. One of them was prepared with pure magnetic nanoparticles and the other one with magnetic nanoparticles coated with 3-aminopropyl trimethoxsilane (APTMS). Both samples were additionally functionalized with diethylenetriamine (deta) and examined using Fourier transform infrared spectroscopy (FTIR), mercury porosimetry, X-ray diffraction analysis (XRD), scanning electron microscopy (SEM-EDS), and transmission electron microscopy (TEM). Silanized magnetit nanoparticles in the synthesized material increased pore diameter by 2.70 and decreased specific surface area by nearly 50% when compared to unsilanized magnetic analog.

Keywords— macroporous, copolymer, magnetic, silanization.

Leuco Dye-Based Thermochromic Systems for Application in Temperature Sensing

Magdalena Wilk-Kozubek, Magdalena Rowińska, Krzysztof Rola, Joanna Cybińska

Abstract—Leuco dye-based thermochromic systems are classified as intelligent materials because they exhibit thermally induced color changes. Thanks to this feature, they are mainly used as temperature sensors in many industrial sectors. For example, placing a thermochromic material on a chemical reactor may warn about exceeding the maximum permitted temperature for a chemical process. Usually two components, a color former and a developer are needed to produce a system with irreversible color change. The color former is an electron donating (proton accepting) compound such as fluoran leuco dye. The developer is an electron accepting (proton donating) compound such as organic carboxylic acid. When the developer melts, the color former - developer complex is created and the thermochromic system becomes colored. Typically, the melting point of the applied developer determines the temperature at which the color change occurs. When the lactone ring of the color former is closed, then the dye is in its colorless state. The ring opening, induced by the addition of a proton, causes the dye to turn into its colored state. Since the color former and the developer are often solid, they can be incorporated into polymer films to facilitate their practical use in industry.

The objective of this research was to fabricate a leuco dye-based thermochromic system that will irreversibly change color after reaching the temperature of 100°C. For this purpose, benzofluoran leuco dye (as color former) and phenoxyacetic acid (as developer with a melting point of 100°C) were introduced into the polymer films during the drop casting process. The film preparation process was optimized in order to obtain thin films with appropriate properties such as transparency, flexibility and homogeneity. Among the optimized factors were the concentration of benzofluoran leuco dye and phenoxyacetic acid, the type, average molecular weight and concentration of the polymer, and the type and concentration of the surfactant. The selected films, containing benzofluoran leuco dye and phenoxyacetic acid, were combined by mild heat treatment. Structural characterization of single and combined films was carried out by FTIR spectroscopy, morphological analysis was performed by optical microscopy and SEM, phase transitions were examined by DSC, color changes were investigated by digital photography and UV-Vis spectroscopy, while emission changes were studied by photoluminescence spectroscopy.

The resulting thermochromic system is colorless at room temperature, but after reaching 100°C the developer melts and it turns irreversibly pink. Therefore, it could be used as an additional sensor

to warn against boiling of water in power plants using water cooling. Currently used electronic temperature indicators are prone to faults and unwanted third-party actions. The sensor constructed in this work is transparent, thanks to which it can be unnoticed by an outsider and constitute a reliable reference for the person responsible for the apparatus.

Keywords—Color developer, leuco dye, thin film, thermochromism.

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M. Wilk-Kozubek is with the Materials Science and Engineering Center, Łukasiewicz Research Network – PORT Polish Center for Technology Development, Wrocław, Poland (e-mail: magdalena.wilk-kozubek@port.lukasiewicz.gov.pl).

M. Rowińska is with the Faculty of Chemistry, University of Wrocław, Wrocław, Poland.

K. Rola is with the Materials Science and Engineering Center, Łukasiewicz Research Network – PORT Polish Center for Technology Development, Wrocław, Poland.

J. Cybińska is with the Materials Science and Engineering Center, Łukasiewicz Research Network – PORT Polish Center for Technology Development, Wrocław, Poland and Faculty of Chemistry, University of Wrocław, Wrocław, Poland.

Sonication as a Versatile Tool for Photocatalysts' Synthesis and Intensification of Flow Photocatalytic Processes Within the Lignocellulose Valorization Concept

J. C. Colmenares, M. Paszkiewicz-Gawron, D. Lomot, S.R. Pradhan, A. Qayyum

Abstract— This work is a report of recent selected experiments of photocatalysis intensification using flow microphotoreactors (fabricated by an ultrasound-based technique) for photocatalytic selective oxidation of benzyl alcohol (BnOH) to benzaldehyde (PhCHO) (in the frame of the concept of lignin valorization), and the proof of concept of intensifying a flow selective photocatalytic oxidation process by acoustic cavitation. The synthesized photocatalysts were characterized by using different techniques such as UV-Vis diffuse reflectance spectroscopy, X-ray diffraction, nitrogen sorption, thermal gravimetric analysis and transmission electron microscopy. More specifically the work will be on:

a. Design and development of metal-containing TiO₂ coated microflow reactor for photocatalytic partial oxidation of benzyl alcohol: The current work introduces an efficient ultrasound-based metal (Fe, Cu, Co)-containing TiO₂ deposition on the inner walls of a perfluoroalkoxy alkanes (PFA) microtube under mild conditions. The experiments were carried out using commercial TiO₂ and sol-gel synthesized TiO₂. The rough surface formed during sonication is the site for the deposition of these nanoparticles in the inner walls of the microtube. The photocatalytic activities of these semiconductor coated fluoropolymer based microreactors were evaluated for the selective oxidation of BnOH to PhCHO in liquid flow phase. The analysis of the results showed that various features/parameters are crucial, and by tuning them, it is feasible to improve the conversion of benzyl alcohol and benzaldehyde selectivity. Among all the metal-containing TiO₂ samples, the 0.5 at% Fe/TiO₂ (both, iron and titanium, as cheap, safe and abundant metals) photocatalyst exhibited the highest BnOH conversion under visible light (515 nm) in a microflow system. This could be explained by the higher crystallite size, high porosity, and flake-like morphology.

sonophotoreactor towards sustainable selective oxidation of key organic model compounds of lignin: Ultrasonication (US)-assisted precipitation and US-assisted hydrothermal methods were used for the synthesis of metal-oxide-based and metal-free-carbon-based photocatalysts, respectively. Additionally, we report selected experiments of intensification of a flow photocatalytic selective oxidation through the use of ultrasonic waves. The effort of our research is focused on the utilization of flow sonophotocatalysis for the selective transformation of lignin-based model molecules by nanostructured metal oxides (e.g. TiO₂), and metal-free carbocatalysts. A plethora of parameters that affects the acoustic cavitation phenomena, and as a result the potential of sonication were investigated (e.g. ultrasound frequency and power). Various important photocatalytic parameters such as the wavelength and intensity of the irradiated light, photocatalyst loading, type of solvent, mixture of solvents, and solution pH were also optimized.

Keywords—heterogeneous photo-catalysis, metal-free carbonaceous materials, selective redox flow sonophotocatalysis, titanium dioxide.

b. Designing/fabricating photocatalysts by a sonochemical approach, and testing them in the appropriate flow

J. C. is with Institute of Physical Chemistry, Polish Academy of Sciences, Poland, Kasprzaka 44/52, 01-224, Warsaw.

M. is with Institute of Physical Chemistry, Polish Academy of Sciences, Poland, Kasprzaka 44/52, 01-224, Warsaw.

D. is with Institute of Physical Chemistry, Polish Academy of Sciences, Poland, Kasprzaka 44/52, 01-224, Warsaw.

S. R. is with Institute of Physical Chemistry, Polish Academy of Sciences, Poland, Kasprzaka 44/52, 01-224, Warsaw.

A. is with Institute of Physical Chemistry, Polish Academy of Sciences, Poland, Kasprzaka 44/52, 01-224, Warsaw.

Kinetic Resolution of Racemic Mixtures via Enantioselective Photocatalysis

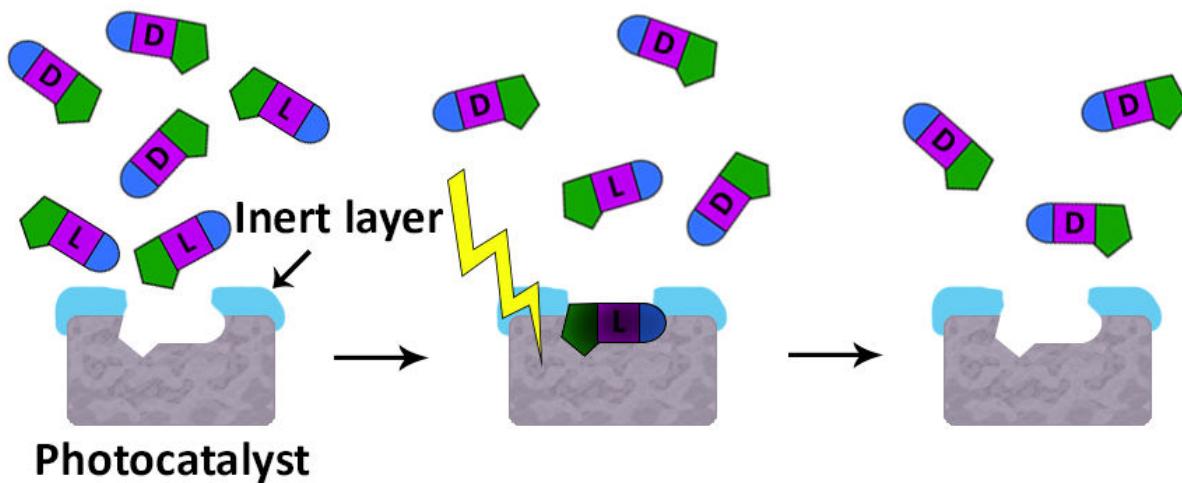
Nitai Arbell^{a,b}, Kesem Bauer^b, Yaron Paz^{a,b*}

^a The Russell Berrie Nanotechnology Institute, Technion-Israel Institute of Technology, Haifa 3200003, Israel

^b The Wolfson Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel

*Email: Paz@technion.ac.il

ABSTRACT: Despite the increasing demand for enantiopure drugs in the pharmaceutical industry, currently available chiral separation technologies are still lagging behind, whether due to throughput or to operability considerations. This manuscript presents a new kinetic resolution method, based on the specific adsorption of a target enantiomer onto a molecularly imprinted surface of a photocatalyst, and its subsequent degradation through a photocatalytic mechanism. The current model system is composed of an active TiO₂ layer, on which the target enantiomer is adsorbed. A photocatalytic suppression layer of Al₂O₃ is then grown around the adsorbed target molecules by Atomic Layer Deposition. Following the removal of the templating molecules, molecularly imprinted cavities that correspond to the adsorbed specie are formed. The stereospecific nature of these pores encourages enantioselective degradation of the undesired specie through its enhanced adsorption on the photocatalyst surface, while dampening non-selective photocatalytic activity around the imprinted sites. The method, demonstrated with the dipeptide Leucylglycine as a model system, revealed a selectivity factor of up to seven, and an enrichment of a single enantiomer to 85% from an initially racemic mixture. The wide range of parameters that can be optimized (photocatalyst, concentration of imprinted sites, type of passivating layer, etc.), points to the large potential of this method for obtaining enantiomerically pure compounds, beginning from racemic mixtures.



Keywords: Chiral resolution, enantioselectivity, photocatalysis, molecular imprinting, modified photocatalysts, molecular recognition, Atomic Layer Deposition, ALD

INTRODUCTION: Chirality is an unusual aspect of chemistry, a seemingly minor detail with surprisingly far-reaching consequences in physical, chemical and biological systems.^{1,2} Despite their large similarity, oppositely handed enantiomers of pharmaceutical compounds are known to exhibit wildly different interactions with biological systems, which are themselves inherently chiral. Proteins and peptides are all chiral structures, encoded in chiral DNA strands that are responsible for their biosynthesis.^{2,3} This gives rise to highly spatially selective interactions between these constructs and molecular substrates, as notoriously demonstrated by the thalidomide catastrophe. This drug, prescribed to pregnant women throughout the 1950's, exhibits strong anti-emetic and sedative properties for its (+) enantiomer, while its (-) enantiomer has significant teratogenic effects, which culminated in tens of thousands of children born with birth defects due to prenatal exposure.^{1,4} Approximately 50% of drugs on the market today contain at least one chiral center. Many of these compounds exhibit pharmacological asymmetry, i.e. have one pharmaceutically useful enantiomer (known as a eutomer) and one or more enantiomers that are non-beneficial or even harmful (distomers).^{5,6} Despite the documented pharmacological asymmetry, some of these compounds are still sold as racemates, even as research shows significant benefits of enantiopure formulations.⁷ Chiral compounds are also of importance in the fields of agriculture and optics.^{8,9}

The challenge, however, is in obtaining chirally pure compounds, as both enantiomers respond to most chemical and physical processes identically. This is usually accomplished by the separation of racemic or scalemic mixtures of enantiomers, or, alternatively, by directly synthesizing the desired enantiomers using asymmetric synthesis methods.^{5,7,10} While extremely useful for many applications, both approaches have their limitations. Asymmetric synthesis, although highly efficient in terms of feedstock, requires the tailoring of complex, multistep, stereoselective reactions, can be relatively expensive, and may also require additional purification steps to reach sufficient optical purity.^{7,10} Separation methods, based on the spatial differences between the enantiomers, require extensive development and optimization, namely selecting an appropriate

separation technique for a specific compound, and optimizing its parameters, such as elution order and resolution or crystallization phase. As a general rule, the optimized parameters are hard to predict.¹¹⁻¹³

One way to overcome this lack of predictable response is through chiral molecular imprinting, i.e. the inclusion of an enantiomerically pure template into the separating matrix to achieve chiral recognition. Chiral imprinting in organic polymers was proposed as an alternative approach to the common chiral chromatography columns, as well as for membrane-based and other retention-based separation techniques.^{7,14-17} Chirally imprinted polymers have also been used for sensing applications.^{18,19} Nevertheless, imprinted polymers may lack in their structural stability, especially under elevated temperatures.²⁰ Molecularly-imprinted inorganic structures, although typically more difficult to prepare due to harsher synthetic conditions, making retention of the templated structure more challenging, were in fact developed earlier.^{21,22} Imprinted oxides have been shown to induce spatial resolution for adsorptive, catalytic and electronic applications.^{23,24} A third group of processes, which can be employed either pre- or post- synthesis, is called kinetic resolution. This is a group of many different reactions which selectively favor one enantiomer over the other, either for the production of the target molecule, or its further reaction into easily separable products.^{25,26}

The use of photocatalysts, especially anatase-phase titanium dioxide, for the degradation of organic compounds is well documented, particularly in environmental sciences and water treatment technologies. It relies on the light-dependent generation of electron-hole pairs that participate in complex redox reactions, usually mediated via radical species.²⁷⁻³⁰ Molecular imprinting in photocatalytic matrices has been shown to induce selectivity for the degradation of the templating specie over homologous alternatives, alas, not for chiral-selectivity applications.^{31,32} It has been shown that coating with ultrathin layers, for example by self-assembly or Atomic Layer Deposition (ALD), may dramatically affect the properties of photocatalysts, by altering the number of carriers arriving at the surface as well as by controlling the adsorption of reactants and the desorption of products.^{33,34} In this context, our work relies on the pioneering work of Canlas et. al. who presented a photocatalytic size-exclusion selectivity effect induced by templating p-tert-butyl-calix[4]arene.³⁵

In what follows, a kinetic resolution method for enriching a mixture of enantiomers is presented. The method is based on imprinting chirally-pure templating species on the surface of a photocatalyst together with mitigating the activity around the templated sites by growing inactive ultrathin layers using ALD. The method is potentially generic in a sense that it is not limited to a specific compound, or enantiomer since the templating molecule may be altered, under some restrictions, at will.

In the specific example demonstrated in this manuscript, the templating molecule (Leucyl-Glycine, LeuGly, Figure S1) is first adsorbed on the surface of the photocatalyst (Figure 1A, (1),(2)). Then, an inert ultrathin layer of aluminum oxide is grown around it (Fig. 1A, (3)). Since in this manuscript the photocatalyst is in the form of a film coating, the inert ALD layer is termed hereby as an "overcoating layer". Removal of the templating molecule, for example by UV-ozone or plasma (Fig. 1A, (4), completes (Fig. 1A, (5)) the preparation stage of this Photocatalytic Enantio-enriching Device (PED). During operation, the PED is placed in a solution containing a racemic

mixture. Preferential degradation of the enantiomers corresponding to the imprinted sites, ends in relative enrichment of the solution with the counter-enantiomer (Figure 1B).

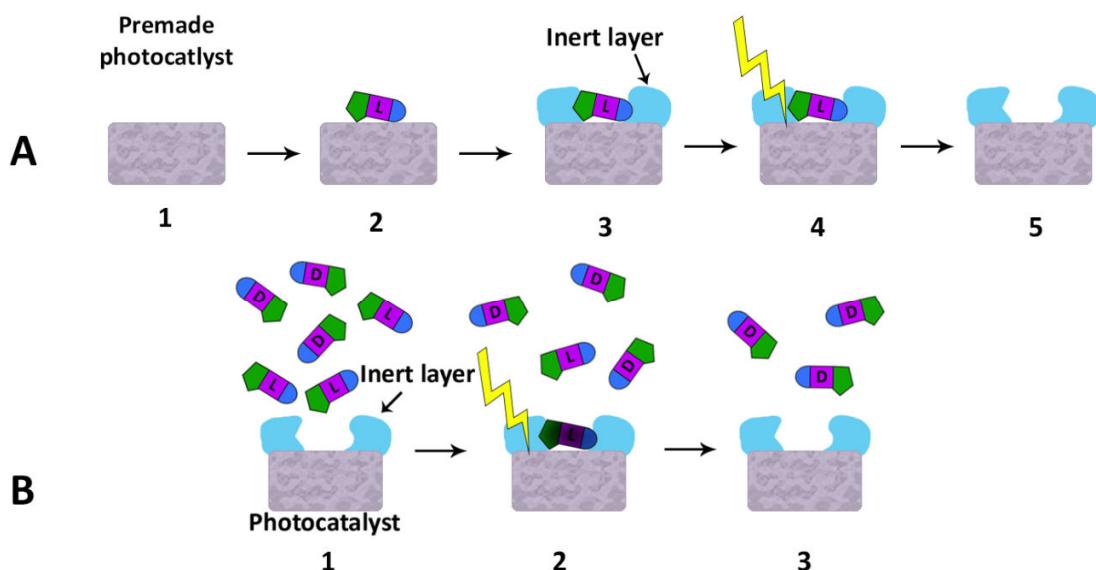


Figure 1. (A) Synthetic scheme for the preparation of a photocatalytic enantioenriching device. (1) photocatalytic matrix (2) adsorption of a templating enantiomer (3) growth of alumina layer by ALD (4) removal of the templating molecule by UV-ozone cleaning (5) prepared device (B) Use of pre-prepared PED to obtain enantioenrichment of a racemic mixture.

EXPERIMENTAL SECTION

Glass slides, onto which films of TiO_2 were deposited, served as starting substrates. This configuration was chosen, despite low specific surface area, due to its simple preparation procedure. LeuGly, a small dipeptide, was chosen as the model molecule due to its single chiral center, the variety of functional groups it has, allowing for several possible interactions with the matrix, and its commercial availability as an enantiopure compound. Al_2O_3 was chosen as the activity-dampening layer due to its significantly larger bandgap relative to that of TiO_2 , its favorable band-locations, the relatively small lattice mismatch with that of anatase-phase titania, and, above all, its suitability for low temperature, thermal ALD growth with mild oxidizing reagents such as water.^{36,37}

Activity Suppression. Testing the passivation capabilities of ALD-grown Al_2O_3 thin-films on TiO_2 was performed by forming thin layers (app. 60 nm) of anatase-phase titania on silica plates using a previously developed spin-coating sol-gel method.³⁸ Part of the plates were overcoated with Al_2O_3 by thermal ALD, using a MVD100E apparatus (SPTS Ltd.).

The ALD procedure comprised of the following stages: introducing the slides into the reaction chamber, pumping down to less than 1 mtorr, introducing nitrogen to obtain a working pressure of

20 mtorr, introducing 1 torr of trimethylaluminum (TMA) for 1s, purging five times with nitrogen, pumping down to the working pressure, introducing 1 torr H₂O for 1 s, purging ten times with nitrogen and pumping down to the working pressure, thus ending the deposition of a one-cycle overcoating layer. This process was repeated according to the predesigned number of layers.

The default temperature during the process was 50°C. Various thicknesses were tested, controlled by altering the number of overcoating cycles (0,4,6,8,12). In addition, an eight-layers sample was grown at 60°C in order to gain insight regarding the effect of surface temperature. To test the activity suppression capabilities of the overcoating layer, the degradation kinetics of stearic acid were tested, following a formerly published procedure,³⁹ allowing simple data analysis due to an initial zero-order rate law and easy concentration monitoring using FTIR.^{33,40} Here, a solution of 5 mg/ml stearic acid solution in methanol was deposited and spun twice at 2500 rpm for two minutes. All plates were then individually placed at a distance of 15cm under a Blakray 100W, 365nm UV lamp for 40 minutes, with measurements taken every 10 minutes. Kinetics were deduced based on monitoring changes in the IR absorption CH₂(a) peak at 2916 cm⁻¹.

PEDs preparation. PEDs comprised of TiO₂ thick-films on 25x12.5 mm glass slides, overcoated with Al₂O₃ were prepared by the following procedure: microscope glass slides (Marienfield) were cleaned by washing in chloroform, ethanol, and deionized water. A mixture of 9.2 gr P25 titania powder (Degussa) and 0.6 gr X-500 titania suspension (TiPE Ltd.) in 12 ml deionized water was thoroughly (15 min.) sonicated (MRC, DC80H) and applied on the glass substrates using the Dr's blade method. The deposited thick films (15 micrometers) were then calcined at 450°C for 5.5 hours to improve adhesion. Next, 300 µl of a 0.25 mg/ml solution of either L-LeuGly (Sigma-Aldrich) or D-LeuGly (Santa Cruz Biotechnology) in deionized water was administered on each of the imprinting-designated slides and spun at 4000RPM for 80 sec. Part of the TiO₂-coated slides, termed hereby as (-,-), were left aside without LeuGly. All the LeuGly-containing plates and half of the (-,-) slides were overcoated with 10 cycles of Al₂O₃ ALD, according to the procedure described above. Here, the deposition temperature for all PEDs was 50 °C. Finally, the alumina-overcoated plates were UV-ozone cleaned for 15 minutes (UVOCS ltd.) to remove the templating molecules prior to reaction. The prepared PEDs were divided into four groups: non-overcoated non-templated plates, denoted as (-,-), overcoated non-templated plates denoted as (+,-), overcoated L-templated plates (+,L) and overcoated D-templated plates (+,D). The photocatalytic thick-film and overcoating aluminum oxide layers were analyzed using XRD (Rigaku, MiniFlex II), XPS (Thermo VG Scientific, Sigma Probe) and SEM+EDS (Zeiss, Ultra-Plus HRSEM).

Additional ultra-high resolution AFM measurements were carried out on PEDs prepared using the same sol-gel procedure used in the Activity Suppression segment. Here, the same templating procedure described above for the P25-containing slides (spin-coating with the templating molecules followed by 10 ALD cycles of Al₂O₃) was performed. One additional sample was made with a templating solution containing 0.5 mg/ml L-LeuGly rather than the 0.25 mg/ml used elsewhere. This type of PEDs was chosen as its corrugation is significantly lower than that of the P25-based PEDs. Such low corrugation is a must in order to sense molecular-level cavities. During the AFM measurements of these samples, the plates were first cleaned for 5 minutes with oxygen plasma and their surface was wetted with a 0.1M NaCl solution to remove air pockets. This was followed by a quasi-static 4-hour stage approach to minimize signal drift, in an in-house upgraded ultra-high resolution AFM setup, reported before.⁴¹

Single enantiomer kinetics. The photocatalytic degradation kinetics of each enantiomer was performed in a reaction vessel comprised of a perforated-bottom 50 ml beaker in which one photocatalytic plate was placed in each experiment. The perforated beaker was introduced into a larger beaker containing a stirring bar, allowing continuous mixing of the solution during the reaction. A glass cover was used to minimize evaporation.

All tests were conducted with 100 ml of an aqueous solution (0.5 mg per ml) of enantiomerically pure (L or D) LeuGly. The photocatalytic plate was placed 15cm below a Blakray 100W 365 nm lamp, following adsorption in the dark for 20 hrs. Each plate was used twice: first with one enantiomer, then with the second. Care was made to alter the sequence of the two enantiomers between repetitions, in order to minimize systematic errors. The concentration of the peptide in solution was determined using a previously developed fluorometric assay utilizing the fluorescent taggant molecule fluorescamine, a method that is enantiomerically blind. [42] The results were fit to a 1st-order apparent mechanism.

Racemate kinetics and enantiomeric enrichment. A set of reactions with racemic mixtures as reactants was carried out in a Radleys 12-vial parallel reaction system modified with twelve intensity-tuned, voltage-controlled 365 nm LEDs, allowing direct illumination of the vertical plates without interfering with stirring. This system is denoted hereby as "the carousel system". All vials were simultaneously illuminated following adsorption equilibrium and were monitored in parallel. Some tests were performed also in the same reactor used for the single enantiomer kinetics studies.

To quantify the concentration of each enantiomer, a chiral-resolving method was developed for an Agilent 1100 HPLC. An Astec Chirobiotic T (4.6 mm x 15 cm) chiral column, with an isocratic mobile phase of 70% (by vol.) methanol and 30% of 50 mM Triethylamine acetate (TEAA) in water at a pH of approximately 6.75 was used. The flow rate was 0.4 ml/min and the temperature was set to 20°C. The run-time was 10 minutes, during which the L enantiomer was the first to elute at 7 minutes, while the D enantiomer eluted 30 seconds later. For all measurements the Resolution Factors were larger than 2.

RESULTS AND DISCUSSION

Activity Suppression. A functional PED relies on sufficient passivation of the photocatalytic surface around the templating molecules. While thick layers easily accomplish this, it is obvious that too-thick a layer is likely to over-bridge (encapsulate) the templating molecules as illustrated in Figure 2(C). Hence, it is essential to look for the thinnest layer that sufficiently hampers the photocatalytic activity, while retaining the full spatial information of the templating molecule. As depicted in Figure 3, the expected trend of activity damping with increasing cycle number was observed, resulting in an apparent complete deactivation of the photocatalyst at 12 cycles. The averaged slopes of the graphs in Figure 3 are given in Table S1.

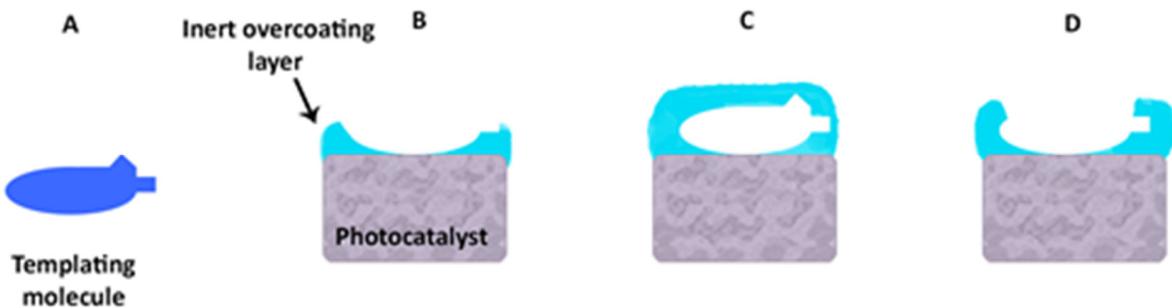


Figure 2. A cartoon describing possible situations during the deposition of an overcoating layer. (A) the templating molecule (the distomer) (B) a PED containing an overcoating layer that is too thin (C) a PED containing an overcoating layer that is too thick, hence overbridging the cavity (D) a PED having an optimal overcoating layer.

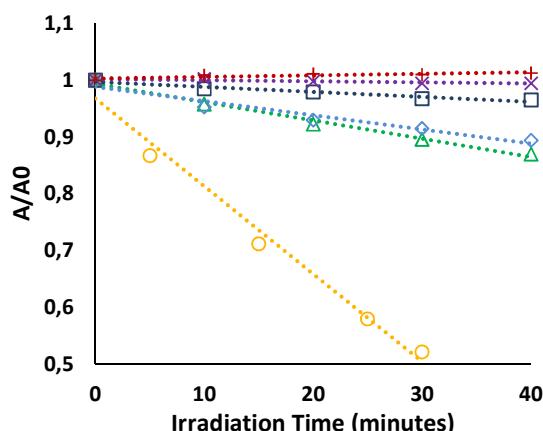


Figure 3. Normalized absorbance of a thin layer of stearic acid deposited on the photocatalytic films as a function of UV-exposure time for different overcoating cycle numbers and temperatures. Open circle represents no overcoating, triangle, diamond, square and cross represent overcoating by 4,6,8 and 12 cycles at 50°C respectively, and X represents overcoating by 8 cycles at 60°C.

PEDs characterization. PEDs comprised of TiO₂ thick-films on glass, overcoated with Al₂O₃ were prepared as described in the experimental section and were characterized by XRD, XPS, AFM and SEM+EDS. The XRD pattern was typical for P25 TiO₂ (i.e. a mixture of anatase and rutile) as the alumina layers were too thin to have any diffraction effect. The SEM-EDS images (Figure 4), revealed the presence of aluminum atoms at the surface, in quite a homogeneous distribution. As expected, the relative amount of aluminum increased upon increasing the number of ALD-growth cycles. It should be noted that all samples, regardless of whether they had been overcoated or not, displayed cracks on their surface (all the way to the glass substrates), however, these cracks are not considered to be a challenge for ALD coating, which is well-suited for irregular, high aspect-ratio topography.⁴³

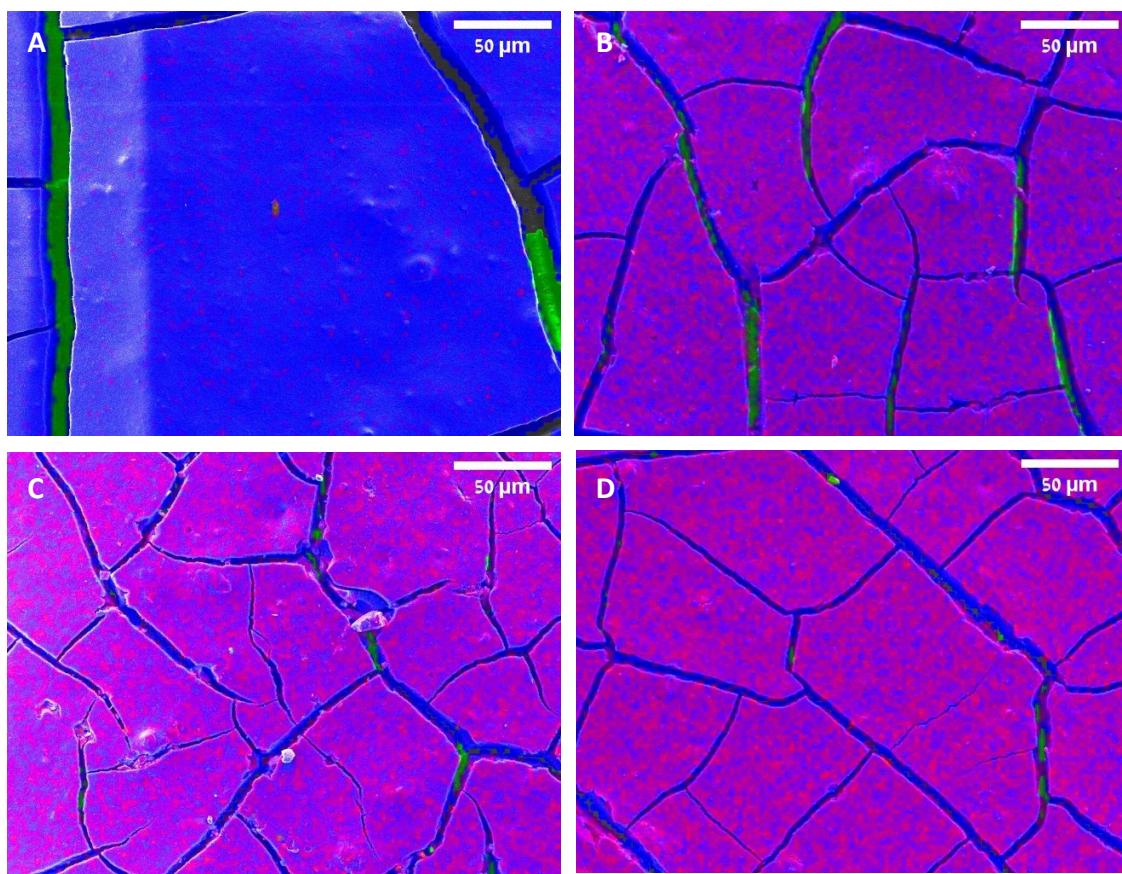


Figure 4. SEM-EDS images of PEDs. (A) TiO_2 film on glass without any overcoating (B) overcoated, imprinted plates with 6 ALD cycles (C) overcoated, imprinted plates with 10 ALD cycles (D) overcoated, imprinted plates with 14 ALD cycles. Color legend: red marks aluminum, blue marks titanium and green represent silicon from the underlying glass substrate.

Table 1 presents the atomic concentration (%), as measured by XPS, of PEDs that had been prepared using imprinting solutions of different concentrations of LeuGly (0, 0.1, 0.5, 1 mg/ml). In all samples the overcoating layer was prepared by ten ALD cycles of alumina. All measurements were performed prior to stripping the templating LeuGly. The concentration of oxygen was found to be $56\pm3\%$. On a free-carbon basis, the atomic concentration of oxygen was 71%, which is slightly higher than expected (60-66%), probably reflecting some contribution of oxygenated species adsorbed on the surface. The atomic concentration of carbon was found to be $18\pm1\%$ for samples prepared with low concentration of imprinting molecules. The lack of distinct trend suggests that most of the carbon signal originated from carbonaceous contamination and from ALD-leftover methyl groups rather than from the imprinting molecules. The high atomic concentration of carbon measured in samples prepared with high concentration of LeuGly suggests that the templating molecules tend to be deposited as aggregates under this condition during preparation. These aggregates may act to ease further adsorption of organic contaminants. The conclusion regarding the presence of aggregates in samples prepared with the highest concentration of LeuGly is further supported by the low atomic concentration of Ti found in such

samples. It should be noted that the XPS measurements were sensitive enough to monitor nitrogen atoms belonging to the LeuGly molecules on the surface, nevertheless, the signal to noise ratio for this rather low concentration atom was insufficient for a detailed quantitative analysis, beyond a positive correlation between solution and surface concentrations. For the above reasons, most of the reported-below results were obtained with PEDs prepared with a 0.25 mg/ml LeuGly solution.

Table 1. XPS atomic concentration (%) of oxygen, carbon, titanium, aluminum and nitrogen atoms in PEDs overcoated with 10 ALD cycles and templated with 0, 0.1, 0.5 and 1 mg/ml solutions of L-LeuGly.

Atomic %	0	0.1	0.5	1
O1s	55.8	57.6	58.3	51.6
C1s	19.9	18.4	16.7	30.4
Ti2p3	13.5	14.1	13.8	7.7
Al2p	10.8	9.8	10.9	9.8
N1s	~0	0.2	0.3	0.4

Ultra-high resolution AFM measurements were performed on PEDs and on non-imprinted titania films overcoated with alumina (ten ALD cycles), in order to verify the presence of molecular cavities in the PEDs. Unfortunately, the roughness of the surface made it impossible to directly observe such small features (Figure S2). Nevertheless, by plotting the distribution (ρ) of heights (z) relative to the minimum of each frame, a clear difference between the two devices was revealed (Figure 5). Here, the height distribution of the coated, non-imprinted film (denoted as (+,-)) peaked around 2 nm, in a gaussian manner. In contrast, the height distribution of the imprinted PEDs was considerably wider and could be resolved into two, partially overlapping, distributions: one that was very similar to that of the (+,-) sample and a second, that peaked around a height of 3 nm. The same effect was even more distinct for the plate prepared with the higher templating molecule concentration, resulting in a bimodal distribution peaking at 2.5 nm and at 4.5 nm. Hence, it may be concluded that the overcoating process did not bridge-over the templating molecules, resulting in the formation of molecular cavities on the surface of the PEDs. It should be noted that the data presented in Figure 5 was determined based on 16,000 points (50 nm x 50 nm), hence is definitely statistically significant. Additional distributions measured over smaller areas (Figure S3) show the same trend.

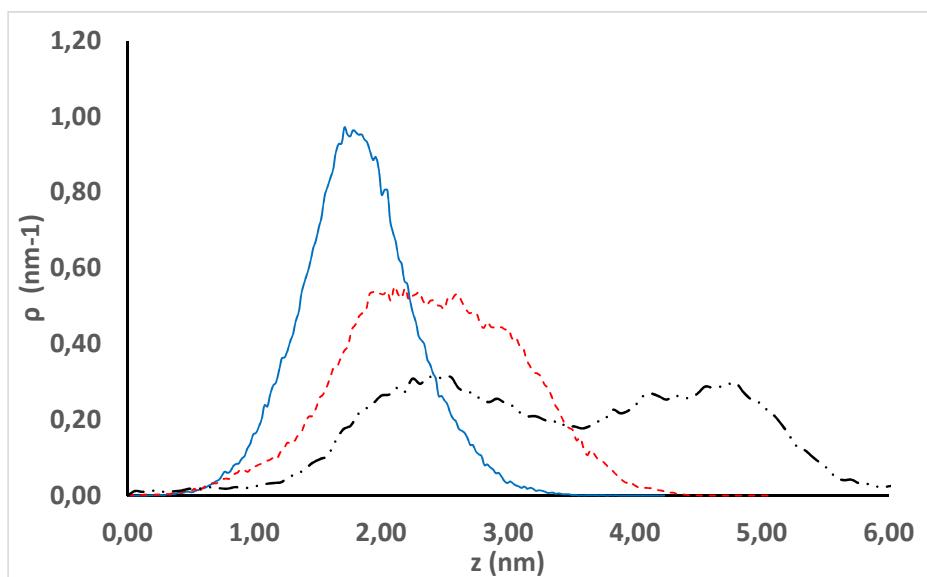


Figure 5. Height distribution functions of the surface of the PEDs as obtained from AFM imaging measured over 50 nm x 50 nm areas. Here, "z" represents the height relative to the minimal height within the frame, while " ρ " is the prevalence. The solid blue line denotes the coated, non-imprinted sample (+,-), the dashed red line denotes the coated, L-imprinted sample (+,L) templated with an 0.25 mg/ml solution of L-LeuGly, and the dot-dashed black line denotes the L-imprinted sample templated with an 0.5 mg/ml solution of L-LeuGly.

Single Enantiomer Kinetics. As an initial test of PEDs, the photocatalytic degradation kinetics of the L-enantiomer of LeuGly was compared with that of the D-enantiomer in an enantiopure solution. This was done both with PEDs and in non-imprinted, non-overcoated TiO₂ films. All PEDs reported in this and in the following sections were overcoated with a 10-cycle ALD layer. This thickness was found to yield higher selectivity than that obtained with imprinted PEDs having thinner layers. As shown in Figure 6A, the degradation kinetics of the L-enantiomer were virtually identical to those of the D-enantiomer on non-imprinted substrates. In contrast, the degradation kinetics of the L-enantiomer were many times faster than those of the D-enantiomer on L-imprinted PEDs (Figure 6B). In a symmetrical manner, the degradation kinetics of the D-enantiomer were significantly faster than those of the L-enantiomer on D-imprinted PEDs (Figure 6C).

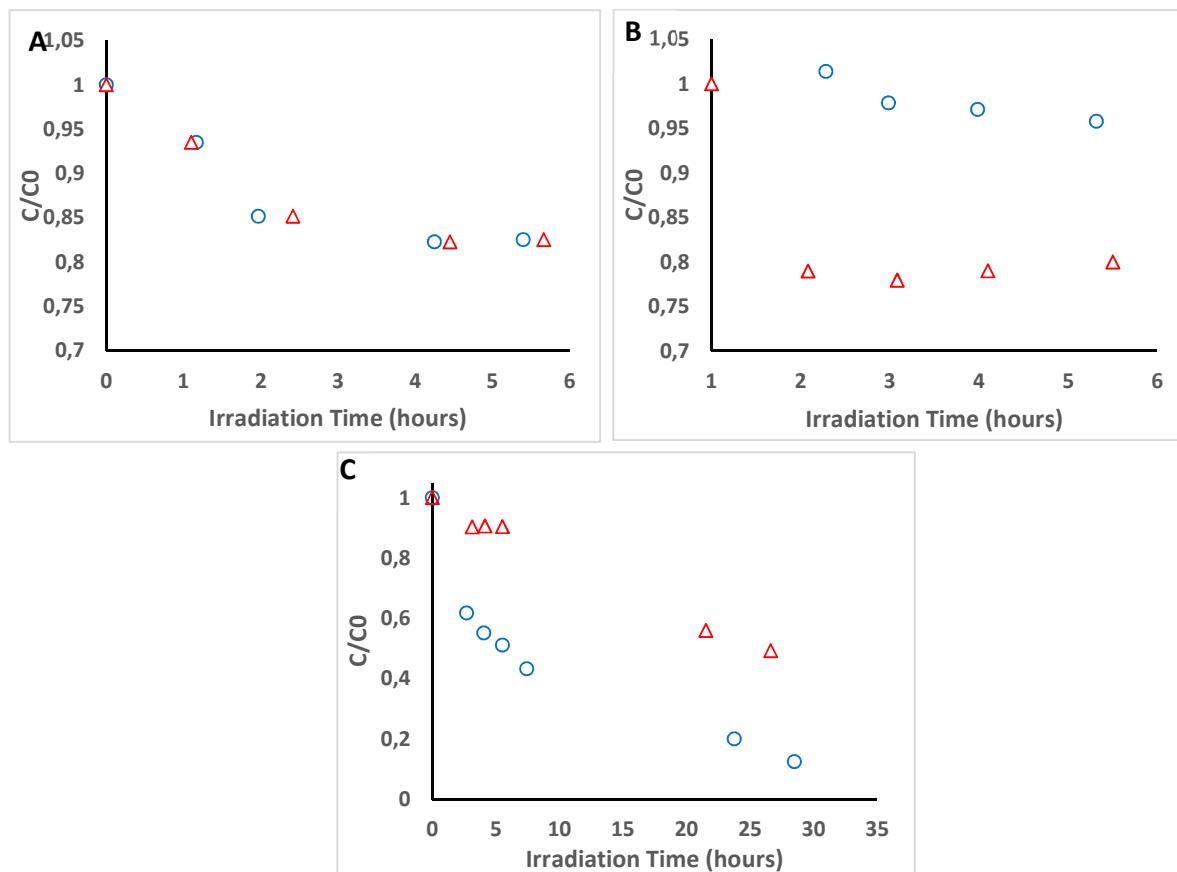


Figure 6. Normalized concentration curves of each single enantiomer test for (A) non-coated, non-imprinted photocatalytic film (-,-), (B) coated, L-imprinted PEDs (+,L) (C) coated, D-imprinted PEDs (+,D). Red triangles represent the normalized concentration of the L enantiomer, while blue circles represent the normalized concentration of the D enantiomer.

To quantify this apparent selectivity effect, the kinetics were fit to a first order rate law (Table 2). As portrayed in the table, in the absence of imprinted cavities, the rate constant for the degradation of the L-enantiomer was almost identical to the rate constant measured for the D-enantiomer. This was not the case with the coated, imprinted PEDs. The rate constant of the L-enantiomer was significantly higher than that of the D-enantiomer upon using L-imprinted PEDs. The opposite was observed upon degrading LeuGly in the presence of D-imprinted PEDs.

Table 2. First order rate constants and L-enantiomer selectivities of the single enantiomer experiment

Plate type	L degradation kinetic constant k _L [1/hr]	D degradation kinetic constant k _D [1/hr]
(-, -)	0.0341	0.035

(+,L)	0.0391	0.0107
(+,D)	0.007	0.0624

The ratios between the rate constants in the degradation of L-enantiomer to those of the D-enantiomer for the three cases are presented in Figure 7. The difference in the kinetics of the degradation of the D- and L- enantiomers for the imprinted PEDs are striking. While both types of templates led to preferential degradation of the corresponding enantiomer, the effect of imprinting the D- enantiomer was larger than that of imprinting the L- enantiomer (9.1 vs. 6.7). A second run maintained the enhanced selectivity for the imprinted species, however, with lower preference, probably due to some incomplete mineralization during the first run.

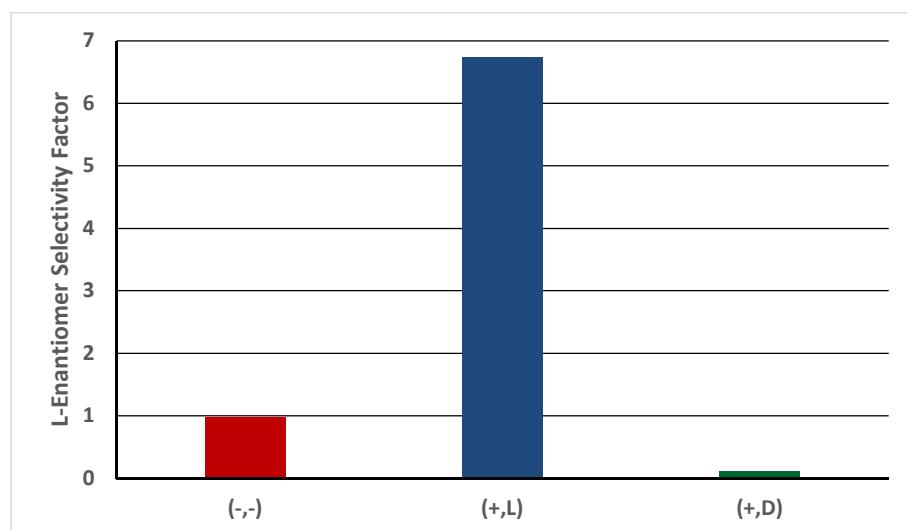


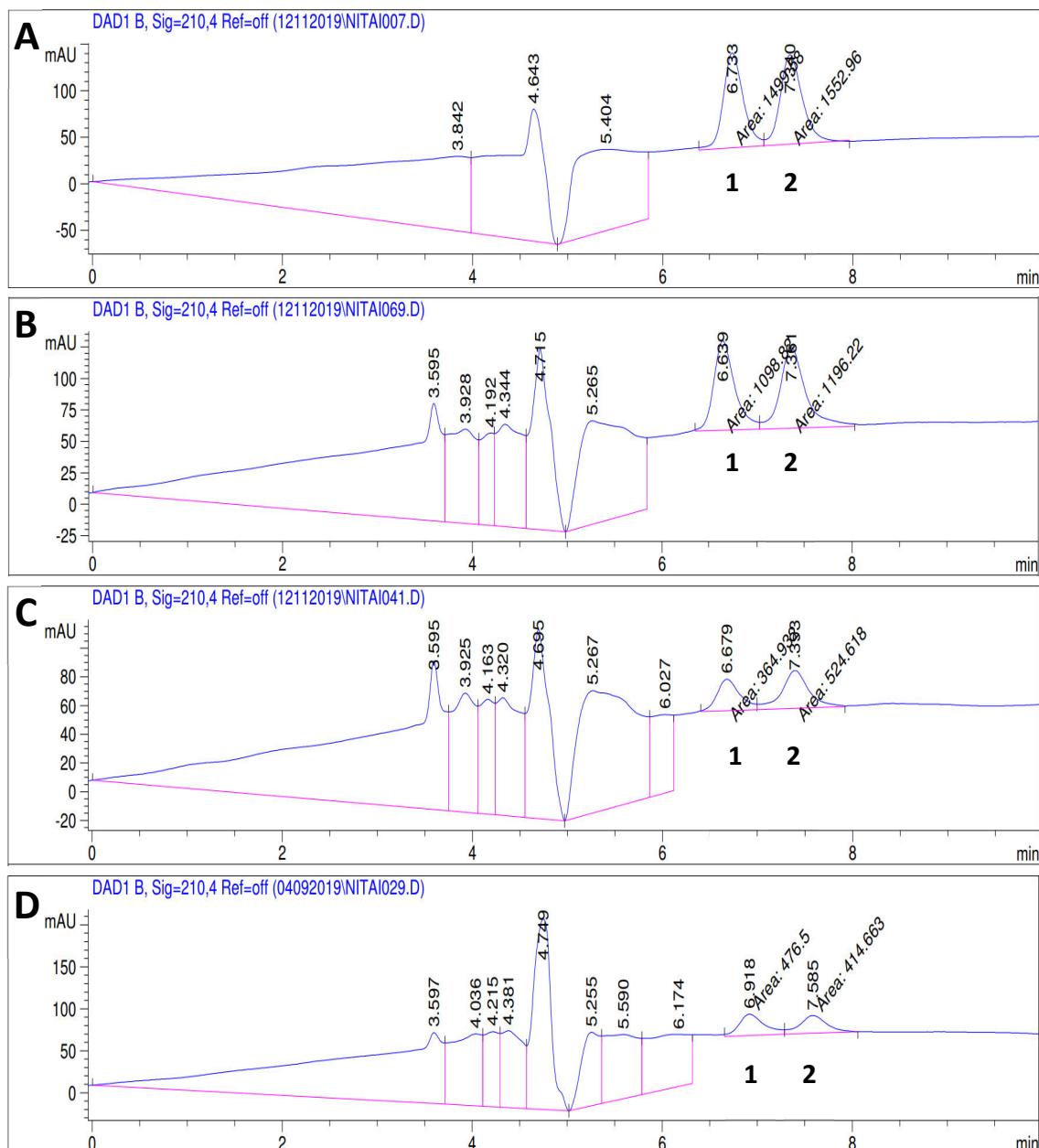
Figure 7. Apparent selectivity factors towards the L-enantiomer (k_L/k_D) for the single-enantiomer degradation tests for the non-coated, non-imprinted PED (-,-), the coated, L-imprinted PED (+,L) and the coated, D-imprinted PED (+,D).

Racemate Enrichment. After assessing the kinetic differences between the enantiomers in separate reactions, the ultimate selectivity test was conducted – enriching an initially racemic solution by preferential degradation of the templating enantiomer.

Figure 8 presents a typical chromatogram of a racemic LeuGly solution, showing the characteristic, well-resolved peaks of the L-enantiomer (1) and the D-enantiomer (2). As can be seen from the figure, the initially racemic solution (Figure 8A) maintained a constant ratio of the L- and D-enantiomers and low degradation rates throughout the reaction carried out on the coated, non-imprinted PED (Figure 8B). The reactions carried out on the imprinted PEDs, however, resulted in both a dramatic increase of the degradation rates, and an uneven reaction progress, with the

templated enantiomer (the distomer) being degraded faster than its counterpart (Figures 8C and 8D).

Figure 8. Chromatograms showing the separation of (1) the L enantiomer and (2) the D-enantiomer of LeuGly, the degradation products and the changing ratio between enantiomers upon



degradation on the imprinted PEDs. (A) The initial racemic solution (B) coated, non-imprinted (+,-) PED after 120 hours of illumination, (C) coated, L-imprinted (+,L) PED after 95.5 hours of illumination, (D) coated, non-imprinted (+,D) PED after 115.5 hours of illumination.

Figure 9 shows the concentration of each enantiomer in the racemic mixture, during the dark adsorption stage (negative times) and the subsequent kinetics during illumination of the PEDs. Regardless of the chirality of the templating specie, the imprinted PEDs revealed an increased adsorption affinity towards their corresponding distomer (Figures 9B, 9C), whereas the non-imprinted control device did not exhibit any preference (Figure 9A). This trend remained also during the illumination stage, in which the molecules were photocatalytically degraded. It should be noted that non-negligible degradation of both enantiomers was measured with the coated, non-imprinted devices (Figure 9A). Since direct photolysis of LeuGly is insignificant in these times scales (as determined in an additional control test), this suggests that the thickness (or conformality) of the alumina overcoating is less than perfect, and can be optimized in a manner that may further increase the enrichment performance of the PEDs. Comparing the kinetics of the eutomers (the D-enantiomer in the L-imprinted PED and the L-enantiomer in the D-imprinted PED) to that of the coated, non-imprinted PED reveals faster degradation kinetics on the imprinted devices. This implies that part of the degradation of the eutomers on the imprinted PEDs occurred within the imprinted cavities. Minimizing such parasitic, residual, degradation may involve increasing the thickness of the overcoating layer as well as tuning the conditions (concentration, pH, temperature etc.) during the templating procedure.

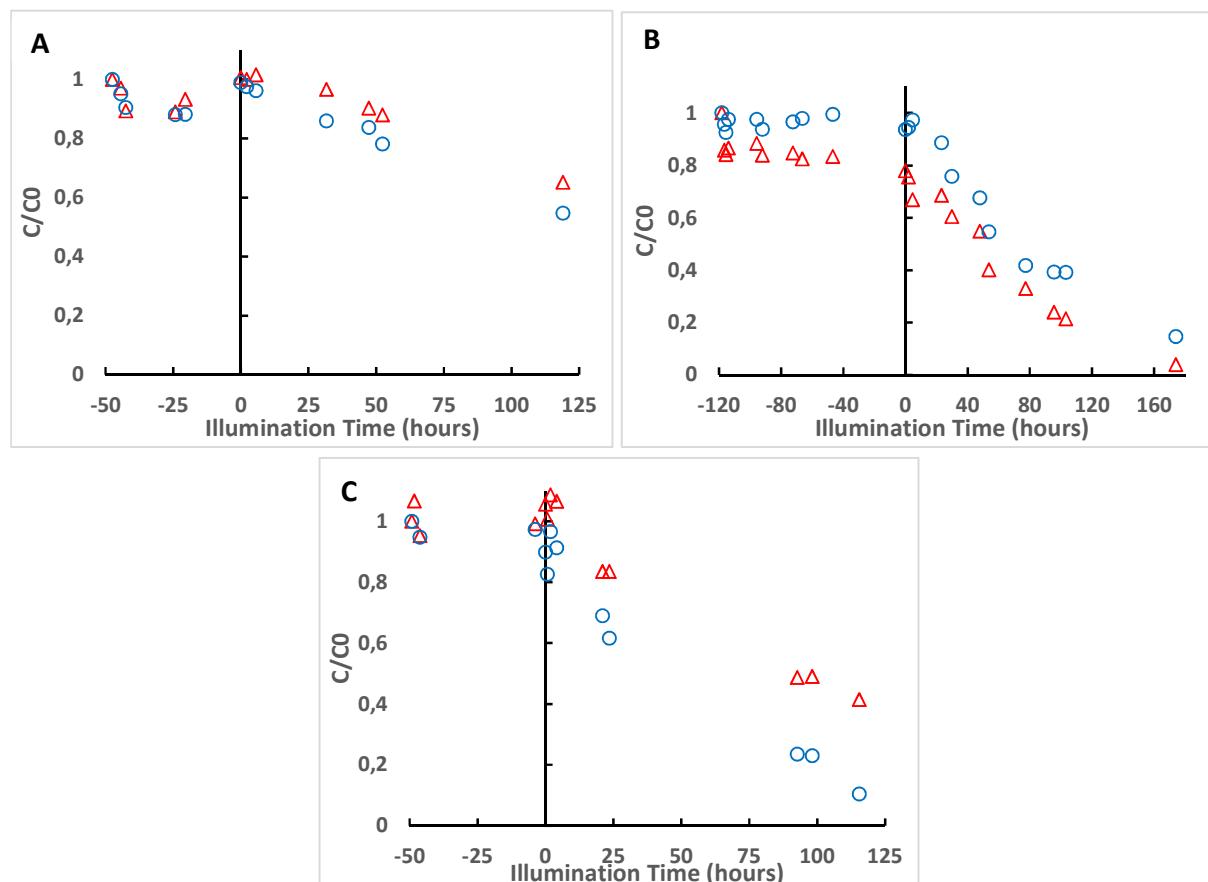


Figure 9. Normalized enantiomeric concentrations during three types of racemate-enrichment tests. (A) non-imprinted, coated PED (+,-) (B) L-imprinted, coated PED (+,L), (C) D-imprinted, coated PED (+,D). Red triangles represent the normalized concentration of the L enantiomer, while blue circles represent the normalized concentration of the D enantiomer. In all traces, negative times represent the "dark", adsorption stage.

The preferential adsorption and photocatalytic degradation kinetics are best represented in the form of enrichment curves (Figure 10), displaying the relative concentration of the L-enantiomer in the three different types of devices (L-imprinting, D-imprinting and non-imprinting) during illumination. Here, an increase in the concentration of the eutomers is clearly observed for both imprinting chiralities. A comparison between D-imprinting and L-imprinting reveals a quasi-symmetrical behavior, with a slight native tendency towards degradation of the D-enantiomer. Sharp-eyed readers may notice that the zero-time ratio between the L- and D- enantiomers are different from 1. This reflects the preferential selectivity during the "dark", adsorption stage.

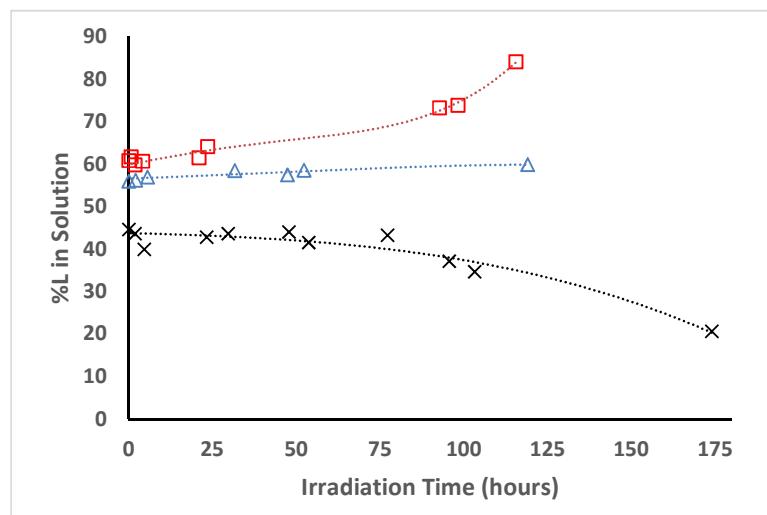


Figure 10. Enrichment curves showing the relative amount of the L-enantiomer in each solution during the three types of racemate-enrichment tests. Black X represent L-imprinted, coated, PEDs, red squares represent D-imprinted, coated, PEDs, and blue triangles represent non-imprinted, coated devices.

Figure 11 presents the averaged L-enantiomer selectivity factor (i.e. k_L/k_D), obtained upon repeating the set of measurements also in the carousel system described in the "methods" section, with four types of plates. As previously discussed this ratio is higher than 1 for the L-imprinted and coated PEDs (1.27 ± 0.1), and lower than 1 for the D-imprinted and coated PEDs (0.78 ± 0.1). As expected, the L-selectivity factor was very close to unity in the absence of imprinting, both for the coated and non-coated samples.

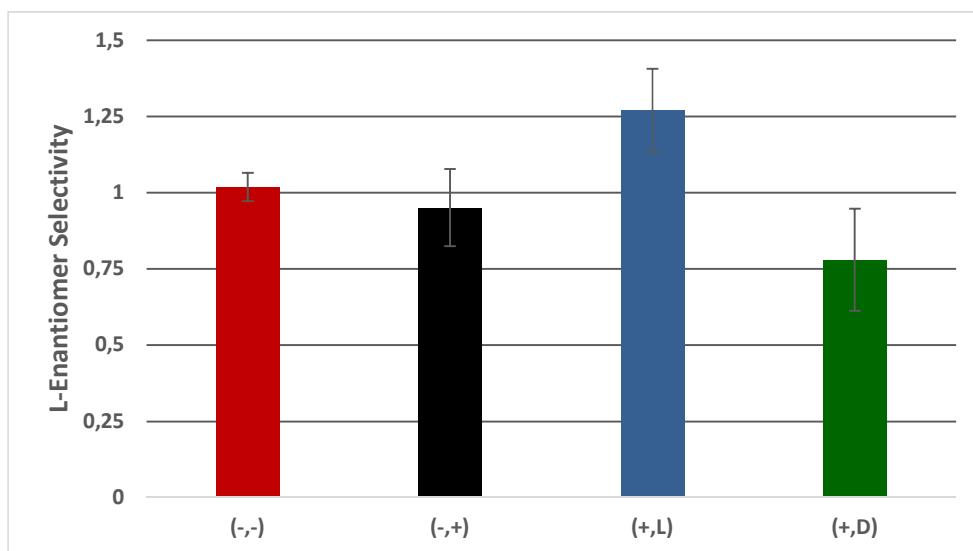


Figure 11. Average values of the L-enantiomer selectivity factors (k_L/k_D) for various types of samples, during the racemate-enrichment experiments: (-,-): non-coated, non-imprinted plates, (+,-): coated, non-imprinted plates, (+,L): coated, L-imprinted plates, (+,D): coated, D-imprinted plates.

A comparison between the results of the single-enantiomer experiments (Figure 7) and the results of the racemate-enrichment experiments (Figure 11) shows higher selectivity in the former set of measurements than in the latter. Such a tendency was observed also with other photocatalytic systems designed for enhanced selectivity between benzene and 2-methyl-1,4-naphthoquinone.⁴⁴ The reason for the discrepancy could be the presence of a mechanism of adsorption of the eutomer on the distomer (or its incompletely mineralized intermediate product) adsorbed within the cavity, leading to enhanced degradation of the eutomer in the racemate enrichment experiments.

From the practical point of view, successful implementation may require significantly shorter timescales than the typical reaction times reported above. In this context, it should be noted that the use of photocatalytic PEDs in the form of powders is expected to dramatically increase the rates, thus shortening the required reaction time. Taking into account a surface area of 50 m² g⁻¹ for the powder, a conservative calculation gives an estimated rate increase of at least one order of magnitude.

CONCLUSIONS

While the holy grail of chiral purification has not yet been found, the device described and tested in this manuscript shows promise of a unique new method for the obtainment of enantiopurity. The method avoids the need for expensive and hard to develop methods for asymmetric synthesis or chiral resolution, by utilizing preferential degradation of the distomer molecules within a racemic mixture.

The method, which relies on imprinting the distomer onto the surface of a photocatalyst while passivating the rest of the surface, was shown to induce high selectivity both with enantiopure and racemic mixture solutions. Significant enrichment values were obtained, with values up to 85% of the eutomer in solution (70% enantiomeric excess) at the end of the process, from an initially racemic solution. Nevertheless, the results indicate that the passivating layer did not completely block non-specific degradation.

The feasibility of using photocatalysis to induce enantiomeric enrichment, demonstrated herein, paves the way for further studies towards optimization and utilization. Two of the crucial factors en-route for commercialization are reducing the reaction time and further increasing the selectivity. The number of process parameters governing the selectivity effect is considerable.

Among these parameters are the optimization of the thickness and conformity of the overcoating layer, tuning the concentration in the templating solution, the use of other photocatalysts (for example, photocatalysts that operate via direct charge transfer), and the introduction of other passivating layers. With respect to reducing the reaction time, it is likely that commercialization may involve the use of particulate PEDs, rather than film-based PEDs that are more convenient for scientific studies. Investigation in these directions is already underway.

Supporting Information

Illustrations L- and D- LeuGly, Ultra-high resolution AFM images of the PEDs, AFM height distributions for smaller areas, kinetic data for the activity reduction measurements of the overcoating layers (PDF).

AUTHOR INFORMATION

Corresponding Author

Yaron Paz – The Wolfson Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel, ORCID: 0000-0002-8161-1123 Email: Paz@technion.ac.il

Authors

Nitai Arbell, The Nanotechnology Graduate Program and The Wolfson Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel

Kesem Bauer, The Wolfson Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel

Notes

The authors declare no competing financial interests.

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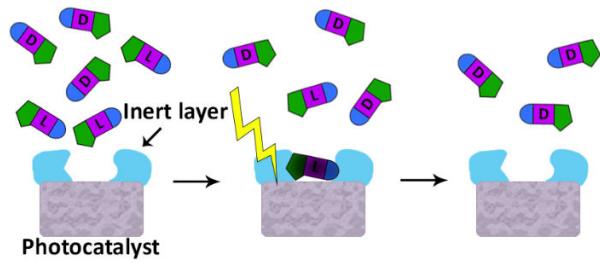
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For Table of Contents Only

Green Amphiphilic Nanostructures from CNSL

E. Bloise, G. Mele

Abstract—In recent years, Cashew Nut Shell Liquid (CNSL) has received great attention from researchers because it is an abundant waste material from the agri-food industry that fits perfectly into the idea of reusing waste from renewable resources for the production of new functional materials. The different components of this waste showed a certain chemical versatility and above all various biological activities. Take advantage of their surface-active capacity in particular conditions, various amphiphilic nanostructures have been prepared through sustainable chemical processes using cardanol (CA) and anacardic acid (AA), as two main components of the CNSL. In-batch solvent-free method has been developed to obtain new versatile green nanovesicles capable of effectively incorporating and stabilizing both hydrophobic and hydrophilic bioactive molecules. Furthermore, these nanosystems have shown antioxidant and cytotoxic properties and, *in vitro* investigations established that they are efficiently taken-up some human cells. With the idea of meeting the principles of green chemistry even more, some improvements of the synthetic procedure have been implemented in terms of milder temperature and pH conditions, producing one-component nanovesicles, in which the AA and CA-derivatives are the sole building block of the green nanosystems. Finally, a new experimental approach has been carried out by a microfluidic route, with the advantage to operate at continuous flows, with a reduced amount of reagents, waste and at lower temperatures, ensuring the achievement of size-monodisperse amphiphilic nanostructures that do not need further purification steps.

Keywords— Bioactive Nanosystems, Bio-based Renewables, Cashew oil, Green Nanoformulations.

E. Bloise is with the Department of Engineering for Innovation, University of Salento, via Monteroni, 73100, Lecce, Italy, (phone: +39 0832297265; e-mail: ermelinda.bloise@unisalento.it).

G. Mele is with the Department of Engineering for Innovation, University of Salento, via Monteroni, 73100, Lecce, Italy, (phone: +39 0832297281; e-mail: giuseppe.mele@unisalento.it)

Fluorescent Terbium-Organic Framework-Doped Polyethylene Composites for FDM 3D Printing in Packaging Security Features

Youssef R.Hassan ^{1*}, Mohamed S. Hasanin², Reda M. Abdelhameed³

¹Packaging materials Department, National Research Centre, 12622, Dokki, Cairo, Egypt

²Cellulose and Paper Department, National Research Centre, 12622, Dokki, Cairo, Egypt

³Applied Organic Chemistry Department, National Research Centre, 33 EL Buhouth St., Dokki, Giza 12622, Egypt.

Abstract

Recently, innovations in packaging security features become more important to see the originality of packaging in industrial application. Luminescent 3d printing materials have been a promising property which can provides a unique opportunity for the design and application of 3D printing. Lack emission of terbium ions, as a source of green emission, in salt form prevent its uses in industrial applications so searching about stable and highly emitter material become more essential. Nowadays, metal organic frameworks (MOFs) play an important role in designing light emitter material. In this work, novel fluorescent high density polyethylene (FHDPE) composite filament with Tb-benzene 1,3,5-tricarboxylate (Tb-BTC) MOFs for 3D printing have been successfully developed. HDPE pellets were mixed with Tb-BTC and melting extrusion with single screw extruders. It was found that Tb-BTC uniformly dispersed in the HDPE matrix and significantly increased the crystallinity of PE, which not only maintained the good thermal property but also improved the mechanical properties of Tb-BTC@HDPE composites. Notably, the composite filaments emitted ultra-bright green light under UV lamp, and the fluorescence intensity increased as the content of Tb-BTC increased. Finally, several brightly luminescent exquisite articles could be manufactured by fused deposition modeling (FDM) 3D printer with these new fluorescent filaments. The development of novel fluorescent Tb-BTC@HDPE composites combined with 3D printing technology.

Keywords: 3D printing - Fluorescent- Packaging – Security.

Water Balance Components under Climate Change in Croatia

J.Bašić, V. Vučetić, M. Anić, T. Bašić

Abstract—Lack of precipitation combined with high temperatures causes great damage to the agriculture and economy in Croatia. Therefore, it is important to understand water circulation and balance. We decided to gain a better insight into the spatial distribution of water balance components (WBC) and their long-term changes in Croatia. WBC are precipitation (P), potential evapotranspiration (PET), actual evapotranspiration (ET), soil moisture content (S), runoff (RO), recharge (R), and soil moisture loss (L). Since measurements of the mentioned components in Croatia are very rare, the Palmer model has been applied to estimate them. We refined method by setting into the account the corrective factor to include influence effects of the wind as well as a maximum soil capacity for specific soil types. We will present one hundred years' time series of PET and ET showing the trends at few meteorological stations and comparison of components of two climatological periods. The meteorological data from 109 stations have been used for the spatial distribution map of the WBC of Croatia.

Keywords—Croatia, long-term trends, the Palmer method, water balance components.

Jelena Bašić is with the in Meteorological and Hydrological Service of Croatia, Croatia (e-mail: basic@cirus.dhz.hr).

The Agroclimatic Atlas of Croatia for the periods 1981–2010 and 1991–2020

V. Vučetić, M. Anić, J. Bašić, P. Svilicić, I. Tomašević

Abstract—The Agroclimatic Atlas of Croatia (Atlas) for the periods 1981–2010 and 1991–2020 is monograph of six chapters in digital form. Detailed descriptions of particular agroclimatological data are given in separate chapters as follows: agroclimatic indices based on air temperature (degree days, Huglin heliothermal index), soil temperature, water balance components (precipitation, potential evapotranspiration, actual evapotranspiration, soil moisture content, runoff, recharge and soil moisture loss) and fire weather indices. The last chapter is a description of the digital methods for the spatial interpolations (R and GIS). The Atlas comprises textual description of the relevant climate characteristic, maps of the spatial distribution of climatological elements at 109 stations (26 stations for soil temperature) and tables of the 30-year mean monthly, seasonal and annual values of climatological parameters at 24 stations. The Atlas was published in 2021, on the seventieth anniversary of the agrometeorology development at the Meteorological and Hydrological Service of Croatia. It is intended to support improvement of sustainable system of agricultural production and forest protection from fire and as a rich source of information for agronomic and forestry experts, but also for the decision-making bodies to use it for the development of strategic plans.

Keywords—agrometeorology, agroclimatic indices, soil temperature, water balance components, fire weather index, Meteorological and Hydrological Service of Croatia.

Jelena Bašić is with the in Meteorological and Hydrological Service of Croatia, Croatia (e-mail: basic@cirus.dhz.hr).

Artificial Seed Production in *Stipagrostis pennata*

Masoumeh Asadi Aghbolaghi^{1*}, Beata Dedicova², Farzad Sharifzadeh¹, Mansoor Omidi¹, and Ulrika Egertsdotter³

Abstract— *Stipagrostis pennata* is one of the valuable fodder plants and is very resistant to drought, due to the low capacity of seed production, the use of asexual reproduction methods, including somatic embryogenesis and artificial seed, can increase its reproduction on a large scale. This study was conducted in order to obtain optimal treatments for the production of artificial seeds of this plant through the somatic embryo encapsulating. Embryonic calluses were encapsulated using sodium alginate and calcium chloride and then sowed in a germination medium. The experiment was conducted as a factorial based on a completely randomized design with three replications. The treatments include three concentrations of sodium alginate (1.5%, 2.5%, and 3.5%), two ion exchange times (20 minutes and 30 minutes), and two artificial seed germination media (hormone free MS and MS containing zeatin riboside and L-proline). Germination percentage and number of days until the beginning of germination were investigated. The highest percentage of artificial seed germination was obtained when 2.5% sodium alginate was used for 30 minutes (ion exchange time) and the seeds were placed on the germination medium containing zeatin riboside and L-proline.

Keywords: somatic embryogenesis, *Stipagrostis pennata*, synthetic seed, tissue culture

I. INTRODUCTION

STIPAGROSTIS *pennata* is one of the valuable pasture species, belonging to the Aristida tribe and the Gramine family. It is also a herbaceous perennial plant with creeping underground stems [32]. This plant is a dominant grass species in the desert areas and in the central desert areas of Iran [4]. The genus Stipagrostis Nees in Iran has eight species, three of which are (*S. karelini* (Trin. & Rupr) Tzvelv; *S. plumosa* (L.) Munro ex T. Anders; *S. pennata* (Trin.) De Winter) grow in the desert sand fields [25].

In addition to Iran, this plant is also distributed in the hot and dry deserts of Africa, India, Iraq, Turkmenistan, Afghanistan, Pakistan, Somalia, Arabia, Egypt, the southern European part of Russia, the Caucasus, and Western Siberia [16].

The plant organ above the soil acts as a barrier against the wind flow, and when the wind flow passes through the plants, its dynamic energy is reduced, hence wind erosion cannot be very effective around grasslands and areas with high plant density (Fig. 1).

According to [10], the adaptability of *S. pennata* species in desert areas indicates that sand-loving plants like this species have different mechanisms in drought conditions, including: having narrow leaves, wax coating on leaves and developed roots. In this species, in addition to the spread and density of the

roots, the stems also grow densely on the soil surface, which have an important effect on reducing wind erosion and carrying sand particles.

This plant can be introduced as a fodder with very little water consumption for livestock in dry areas due to its edible and bushy aerial parts. Considering that the natural seeds of the *S. pennata* hardly germinate and grow [3], and it is a species in danger of extinction, so the propagation technique through artificial seeds offers a high potential to preserve this species.

In early studies, artificial seeds only referred to encapsulated somatic embryos. Following the use of artificial seeds, shoot tip parts, axillary buds and stem nodes have also been used as suitable options for the production of somatic embryos and artificial seeds [1], [6], [23], [24].

Artificial seed is an encapsulated meristem tissue that has the ability to transform into a complete plant in in vitro or in vivo condition and maintains this ability [5].

The technology of artificial seed production has provided an excellent opportunity for the production of hybrids, portable genotypes, production of plants with inaccessible seeds, as well as genetically engineered plants [17].

In general, the goal of artificial seed technology development is to create colonies that can store somatic explants for a long time and multiply the plant in large numbers at the same time. Converting to plant process is the most important aspect of artificial seed technology.

Reference [18] used sodium alginate solution and calcium salt solution in the production of artificial carrot seeds.

Reference [29] prepared embryonic callus from *Hyparrhenia hirta* using combination of 2-4-D and Benzylaminopurine and used the resulting embryos in MS (Murashige and Skoog) medium containing three percent sodium alginate to produce artificial seeds [21]. After seven weeks of sowing the seeds in the solid medium, half of the seedlings emerged.

Reference [15] obtained the highest germination percentage of *Hyparrhenia hirta* artificial seeds when three percent sodium alginate and 75 mM calcium chloride were used for 30 minutes to encapsulate somatic embryos.

Reference [13] also investigated different concentrations of alginate and the duration of exposure in calcium chloride in the production of artificial Eucalypt seeds and stated that three percent sodium alginate and exposure in 100 mM CaCl₂.2H₂O solution to For 30 minutes, the seeds will be uniform, round, transparent, and firm.

¹ Department of Agronomy and Plant Breeding, College of Agriculture and Natural Resources, University of Tehran, P.O. Box 4111, Karaj 31587-11167, Iran.

² Department of Plant Breeding, Swedish University of Agricultural Sciences (SLU), Alnarp Box 190, 23422 Lomma, Sweden

³ Department of Forest Genetics and Plant Physiology, Umeå Plant Science Center (UPSC), Swedish University of Agricultural Science (SLU), SE 901 83 Umeå, Sweden/ G.W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, 500 Tenth Street NW, 30332-0620 Atlanta, GA. USA
* Correspondence: asadi.ma@ut.ac.ir / asadi.m66@gmail.com



Fig. 1 A view of the *Stipagrostis pennata* in the desert (a), and its seeds (b)

Reference [30] encapsulated somatic embryos using sodium alginate in order to produce artificial seeds in two genotypes of the medicinal Chavil plant (*Ferulago angulata* L.). In this way, the somatic embryos were transferred to full and liquid MS medium, mixed in two and three percent sodium alginate and dripped in calcium chloride solution and formed calcium alginate capsules within 10 and 30 minutes. The results of this experiment showed that in Chel Cheshma variety sodium alginate two percent and calcium chloride 25 mM and time 30 minutes and in Kouh Gol variety sodium alginate three percent, calcium chloride 50 mM and time 30 minutes was desirable for artificial seed production with maximum germination.

Reference [20] in order to investigate the effect of alginate matrix composition on the growth rate of artificial seeds obtained by encapsulating somatic embryos in two sunflower hybrids, showed plant regeneration from encapsulated somatic embryos in in vitro and also the establishment of the seedlings after transfer to the in vivo were affected of sodium alginate concentration, the presence, or absence of nutrients in the MS culture medium (macro and micro elements with sucrose) and growth regulators. In this experiment, the presence of nutrients produced stronger seedlings and the presence of growth regulators in the encapsulating matrix caused more branches and leaves as well as a wider root system in the obtained seedlings.

In [31], artificial seeds of Royal variety cucumber had acceptable germination (57%) up to 10 weeks of storage, but the germination percentage reached zero after 14 weeks of storage at 4°C.

During an experiment, encapsulated the tips of the branches obtained from the in vitro propagated sunflower seedlings with 3% sodium alginate and 100 mM CaCl₂.2H₂O. To prepare sodium alginate, three different compounds were used, including sterile distilled water, liquid MS medium, and liquid MS medium with 2 mg/L of benzyl adenine and 2 mg/L of indole acetic acid [19].

In order to evaluate the ability of germination, the artificial seeds were transferred to MS medium without hormones and two commercial substrates Coco Peat and perlite and a mixture of Coco Peat, Perlite and Peat Moss. The use of nutrients and growth regulators in the alginate matrix significantly improved the regrowth of encapsulated branch tips. The highest rate of conversion of synthetic seeds was 100%, which was obtained from sowing on MS medium, and direct sowing in in vivo conditions reduced their ability to transform and grow.

II. MATERIALS AND METHODS

In previous experiments, the best callus induction and embryogenesis media have been reported for *Stipagrostis pennata* [2]. For the production of artificial seeds, the embryos obtained from the MS culture medium with 3 mg/L 2-4-D were used. In this way, the MS medium without calcium chloride was considered as endosperm and the embryos were encapsulated in its bed.

The treatments of this experiment are three concentrations of sodium alginate including 1.5%, 2.5%, and 3.5%, two times for ion exchange including 20 and 30 minutes, and two different culture mediums (MS medium without hormones and MS medium containing zeatin riboside and L-proline) were used for the germination of artificial seeds. The experiment was carried out as a factorial experiment based on a completely randomized design with three replications.

For each treatment, 100 ml of MS medium with a pH of 5.6 to 5.8 was mixed with 100 ml of sodium alginate solution with twice the desired concentration by a sterile autoclave until 200 ml of the endosperm to be obtained. In order to isolate, the embryos were passed through a sterile 500-micrometer sieve and transferred into the prepared endosperm.

The resulting mixture was dripped in 1% calcium chloride solution by a sterile pipette. It should be noted that the calcium chloride solution was already autoclaved and cooled. Mixing sodium alginate and calcium chloride causes the exchange of ions and the replacement of sodium ion by calcium ion, and finally the formation of calcium alginate capsules that surround the embryos.

The time treatment at this stage included 20 minutes and 30 minutes of ion exchange time. After these times, the extra ions were washed from the surface of the capsules by rinsing three times with autoclaved distilled water. Finally, the excess water was dried using sterile filter paper and the seeds were placed in

a petri dish for the storage period, the lids of the dishes were closed with parafilm and kept at a temperature of 4°C (Fig. 2).

After one month of storage, the seeds were cultured on two types of MS media and placed in a growth chamber with a temperature of 25°C (25 seeds in each petri dish) for germination test. The first culture medium of MS was without hormones, but 5 mg/L of zeatin riboside and 500 mg/L of L-proline were added to the second medium after autoclaving. The pH of the media was adjusted between 5.6-5.8 and their solidification was done by adding 3 g/L of gelrite. Finally, germination percentage and number of days until the beginning of germination were measured.

Statistical analysis was done using SAS 9.2 software. Treatments were grouped using the Proc glm method and based on Duncan's multi-range test and alpha equal to 0.05%, and graphs were drawn using Excel 2016 software.

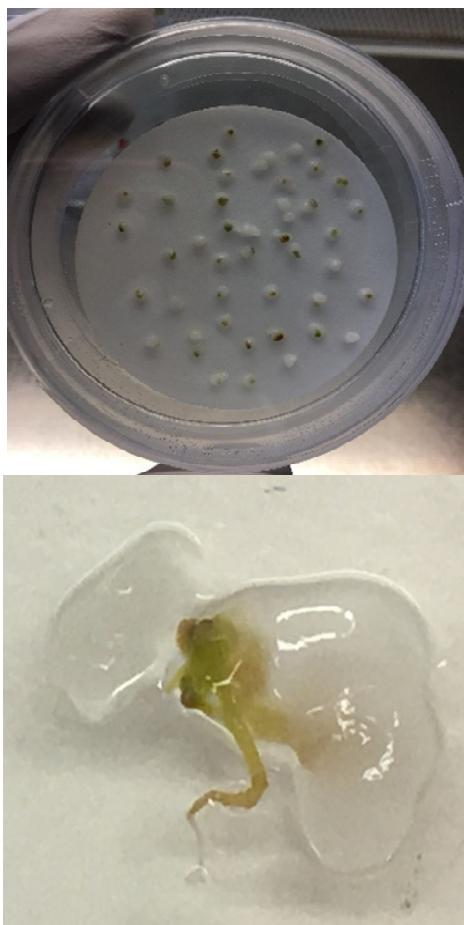


Fig. 2 Artificial seeds of *Stipagrostis pennata* (a), Germinated artificial seed (b).

III. RESULTS AND DISCUSSION

The present study was conducted in order to determine the best concentration of somatic embryo encapsulating compounds for artificial seed production and optimal germination of these seeds.

According to the analysis of variance, the percentage of germination and the number of days until germination were not affected by the triple interaction of the treatments. On the other hand, the interaction of the germination medium at the time of ion exchange did not have a significant effect on the percentage of germination, but the main effects of the treatments, the interaction of the germination medium at the concentration of sodium alginate and the interaction of the concentration of sodium alginate at the time of ion exchange had a significance effect on these characteristics (Table I).

Also, the number of days to germination is significantly influenced by the main effects, the interaction of the germination medium at the time of ion exchange, the interaction of the germination medium at the concentration of sodium alginate and the interaction of the concentration of sodium alginate at the time of ion exchange (Table I).

Comparison of the means showed the highest percentage of germination was related to the use of 2.5% sodium alginate in MS medium containing zeatin ribozide and L-proline. Also, the lowest germination percentage was observed in MS medium without hormone and 3.5% sodium alginate application (Fig. 3).

The application of 2.5% sodium alginate and 30 minutes of ion exchange time increased the germination percentage of artificial seeds, and the highest amount of germination was in the interaction of sodium alginate application at ion exchange time. On the other hand, the use of 3.5% sodium alginate in both ion exchange times caused the lowest germination percentage (Fig. 4).

The maximum time until the germination of artificial seeds was obtained in MS medium without hormones with the use of 3.5% sodium alginate (Fig. 5) and the use of 2.5% sodium alginate in the medium containing zeatin riboside and L-proline, showed the shortest time for germination. It was also found that in the hormone-free medium and the application of 1.5% and 2.5% alginate and the medium containing zeatin riboside and L-proline and the application of 3.5%, the results were statistically similar.

In the mean comparison of the medium during ion exchange, it was observed that if the medium is free of hormones and the ion exchange time is determined to be 20 minutes, the maximum time will be required until germination begins (Fig. 6). Also, if the medium contains zeatin riboside and L-proline (no difference in ion exchange time at 20 minutes and 30 minutes), the embryo took the least time to get out of the capsule.

The interaction between the sodium alginate concentration and ion exchange time on the number of days until the beginning of germination showed at the concentration of 2.5% sodium alginate (with both ion exchange times) and 1.5% (with 30 minutes ion exchange), the synthetic seed needs the least number of days for germination (Fig. 7). On the other hand, the longest time for the embryo to germinate corresponds to the concentration of 3.5% sodium alginate. (both times of ion exchange).

The use of sodium alginate is important in the formation of artificial seeds. Increase in sodium alginate concentration

causes the hardness of the explant protective gel and will have a negative effect on the percentage of germination and the time to sprout seedling from the capsule. This is despite the fact that sodium alginate in very low concentrations does not help to maintain the proper shape and storage of artificial seeds. Because, the formed capsule is very soft and flexible and cannot support the explant well against movement and physical pressure [27].

In an experiment by [11], three sodium alginate concentrations of 1.5%, 3% and 4.5% were used in the preparation of *Drimiopsis* artificial seeds. Even though the highest percentage of germination was obtained in the concentration of 1.5% sodium alginate, it was found that the created capsules were not well polymerized and were not suitable for carrying. The concentration of 3% was considered as the optimal condition. On the other hand, the concentration of 4.5% sodium alginate greatly reduced the germination percentage and the embryo was not able to exit the capsule due to its high hardness. Similar results have been obtained by [7] regarding the optimal concentration of three percent sodium alginate.

The research of [14] on oil palm explants showed the interaction of 2.5% sodium alginate concentration and 15 minutes of ion exchange time had the best germination percentage of artificial seeds. Also, excessive softness of the capsule at two percent concentration and high hardness of the gel matrix at three percent concentration of sodium alginate were stated as reasons for the decrease in germination percentage.

Investigating the interaction of the medium in sodium alginate showed that the highest percentage of germination was in the treatment of hormone free medium and 2.5% concentration of sodium alginate (Fig. 3). Also, the results of the interaction between ion exchange time and sodium alginate concentration showed that the concentration of 2.5% sodium alginate in the ion exchange period of 30 minutes (Fig. 4) was the best treatment combination.

Considering these results and examining the results of other researches, it seems that the concentration of sodium alginate played a central role in the formation of artificial seeds of *Stipagrostis pennata*. According to observations, if the appropriate concentration of sodium alginate (both lack and excess concentration) is not present in the gel matrix, with a concentration of 1.5% and the presence of hormones, 27% compared to a concentration of 2.5% and the presence of hormones reduced germination. This amount of reduction was 74% with the concentration of 3.5% and the presence of hormone (Fig. 3). Similarly, the time of 30 minutes for ion exchange and the concentration of 2.5% sodium alginate showed a 17% increase in the percentage of germination, which was lower than the statistical level (Fig. 4).

According [9], the best treatment for artificial seed production was 3.5% sodium alginate and ion exchange time of 40 minutes. It seems that the shorter time in the present experiment (30 minutes) may be due to the synergistic effects

of alginate and calcium compounds, as well as their concentration, which is similar to the results of another research [14]. In fact, both sodium alginate concentration and calcium compounds are important in the polymerization process [26].

Extensive results have been obtained regarding the role of nutrients in the culture environment, including various types of sugars, hormones, etc. According [28], adding 30 g/L of sucrose to the culture medium containing sugar beet explants had the highest germination percentage compared to higher concentrations. In addition, it showed the shortest for germination. Other research also stated that the presence of nutrient in the alginate matrix led to better regeneration of explants [22].

The presence of nutrients in the gel matrix, which are placed around the explant as a nutritional substrate, probably improved the growth and survival of the *Stipagrostis pennata* explants. Because it can be assumed that L-proline is needed for providing energy for germination. On the other hand, the presence of zeatin riboside stimulated the explant to grow and produce mature seedlings.

It has been found that sucrose was the most suitable source of carbon supply for the eggplant artificial seed production [12]. On the other hand, [28] stated that the presence of hormones in the culture medium decreased the time it took for explants to exit the capsule and also increased the germination percentage of explants, which was in line with the results of the present study. Similar results were obtained in the production of artificial seeds of *Tylophora indica* [8]. The highest percentage of germination and the highest degree of polymerization of the capsule around the explant and at the same time the shortest time until the germination were obtained with a concentration of three percent sodium alginate.

In general, according to the results, the most suitable conditions for the production of artificial seeds of the *Stipagrostis pennata* is the use of 2.5% sodium alginate with the duration of ion exchange for 30 minutes and putting artificial seeds on the culture medium containing hormones and nutrients (zeatin riboside + L-proline). However, it seems necessary to conduct more tests, especially considering the storage period.

In the process of artificial seed production, mature embryos encapsulated using sodium alginate concentration of 2.5%, ion exchange time of 30 minutes and MS germination medium containing zeatin riboside and L-proline showed the highest germination percentage.

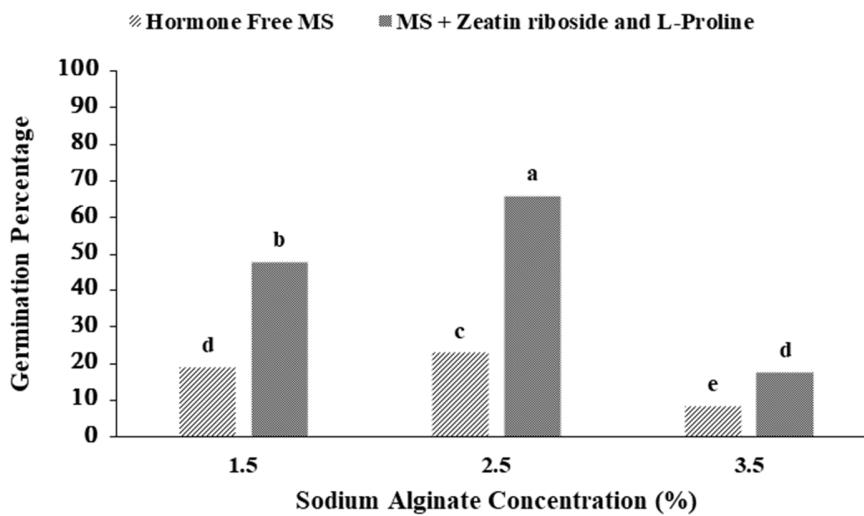


Fig. 3 Mean comparison of germination percentage under the influence of germination medium and sodium alginate concentration in artificial seeds of *Stipagrostis pennata*. Columns with a common letter do not differ significantly from each other.

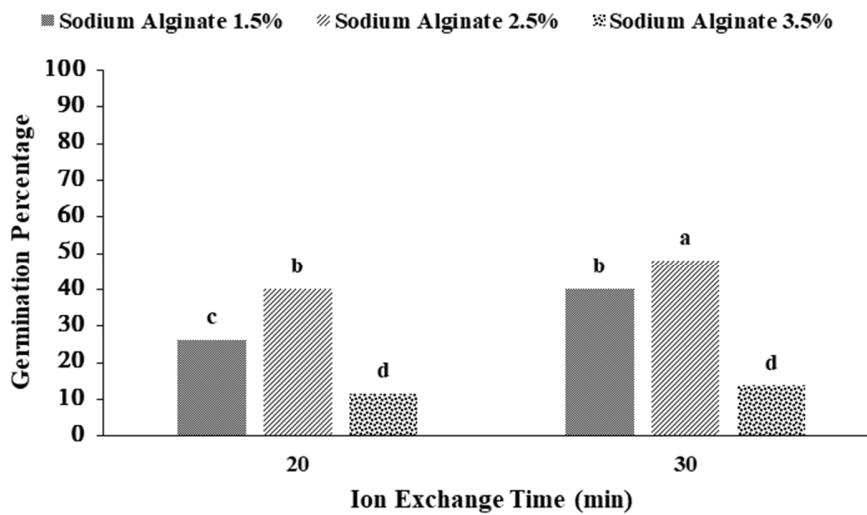


Fig. 4 Mean comparison of germination percentage under the influence of ion exchange time and sodium alginate concentration in synthetic seeds of *Stipagrostis pennata*. Columns with a common letter do not differ significantly from each other

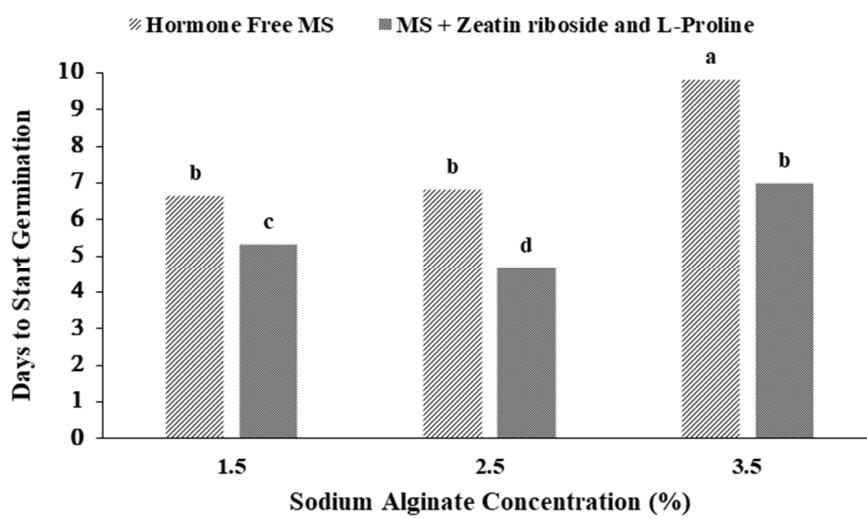


Fig. 5 Mean comparison of number of days until the beginning of germination under the influence of the germination medium and sodium alginate concentration in artificial seeds of *Stipagrostis pennata*. Columns with a common letter do not differ significantly from each other.

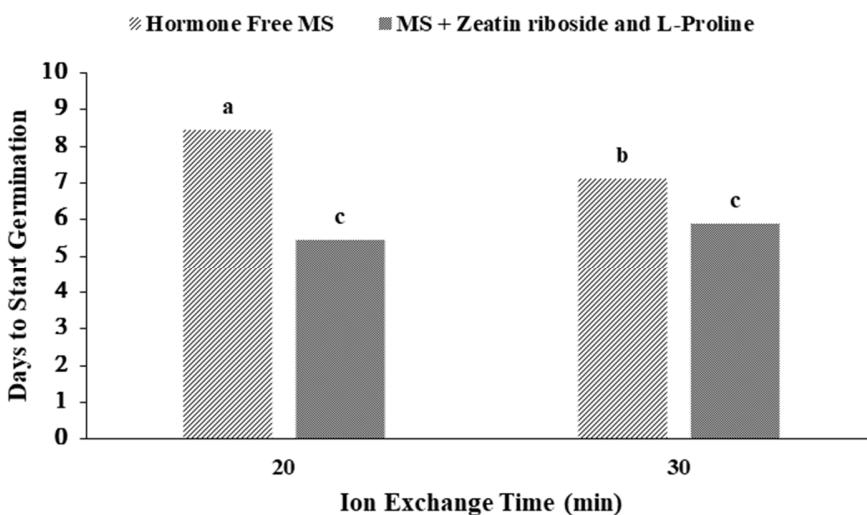


Fig. 6 Mean comparison of days until the beginning of germination under the influence of germination medium and ion exchange time in artificial seeds of *Stipagrostis pennata*. Columns with a common letter do not differ significantly from each other.

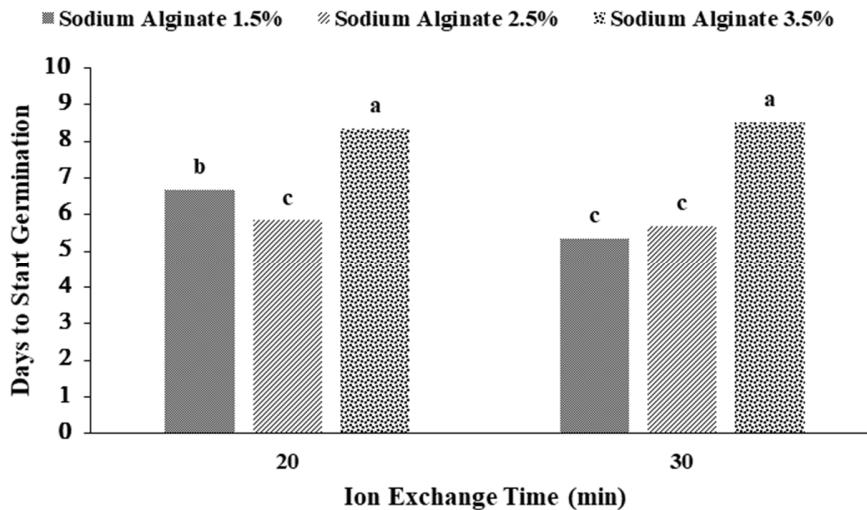


Fig. 7 Mean comparison of the number of days until the beginning of germination under the influence of sodium alginate concentration and ion exchange time in artificial seeds of *Stipagrostis pennata*. Columns with a common letter do not differ significantly from each other.

TABLE I
Variance Analysis Of The Effect Of Germination Medium, Sodium Alginate Concentrations And Ion Exchange Time On The Percentage Of Germination And The Number Of Days Until Germination In *Stipagrostis Pennata*

SOV	df	MS	
		Germination (%)	Days to start germination
Germination medium (M)	1	6588.02**	40.11**
Sodium alginate (S)	2	3049.69**	26.02**
Ion exchange time (T)	1	584.02**	1.77*
M×S	2	867.02**	1.69**
M×T	1	38.02 ^{ns}	7.11**
S×T	2	105.02**	1.86**
M×S×T	2	3.02 ^{ns}	0.52 ^{ns}
Error	24	9.94	0.25
CV (%)	-	10.5	7.4

^{ns}, ** and * , non-significant and significant at 1 and 5 % probability level, respectively

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Agriculture and Climate Change in the Middle East and North Africa Region

Assaad Ghazouani

assaad.ghazouani@fsjegj.rnu.tn

Abstract :

The current vulnerability to climate change and extreme events is a major threat to agricultural systems. This vulnerability depends on the sensitivity and exposure to weather conditions and the ability to adapt to changes in these conditions. The Middle East and North Africa (MENA) region is an example of a region that is currently highly vulnerable to food insecurity. Floods, drought conditions, and pest infestations are some of the current stressors on food security that can be influenced by future climate change. All development initiatives related to agriculture and the ongoing response options may be limited by inefficient institutional structures and the lack of information with potentially negative consequences for future adaptations to increased stress. Therefore, in this context, we tried to analyze the impact of climate change (temperature rise) on wheat in the MENA region, and there is evidence that climate change will have a disastrous impact on the yield of wheat this will increase the vulnerability to food insecurity countries, hence the need to develop adaptation strategies.

Introduction

Over the past five years, the world has been hit by a series of economic, financial and food crises have slowed and sometimes annoyed, global efforts to reduce poverty and hunger. Today, price volatility and climate shocks - such as the devastating drought in the Horn of Africa - continue to seriously undermine these efforts.

Soaring food prices which is observed in global markets since 2006 is likely part of a bullish long term trend and unstable, due to an imbalance between demand and supply of food products, imbalance exacerbated by erratic and more extreme weather conditions and poor functioning of agricultural markets. The strongest correlation between food prices and energy prices is an important factor that can aggravate the situation.

On this basis, we will try in this article to empirically assess the impact of climate change (temperature rise) on wheat production in the countries of the MENA region. Methodologically it is now placed in its own dynamic approach to each country. The question that arises at this level is how you expect wheat production in these countries in the context of climate change?

We will review the main studies that Treaty topic at the first section, the second section in the model used and the data and finally in the third section the main results.

1. Empirical literature review

Gallup et al. (1999) emphasize the relationship between geography, macroeconomic growth and the state, and on the direct role of geography on productivity. They explain that climate change has a significant impact on income through transportation costs and agricultural productivity.

Dell et al. (2009) examine the impact of climate variables - the average temperature and average rainfall on income and GDP for 12 countries in the northern hemisphere between 1950- 2000. The OLS analysis reflects the negative impact of temperature.

Bartomeus et al (2013) using a panel of 134 countries between 1950 and 2005 suggest that warm years are associated with low production per capita in countries with hot climates and production higher per capita for countries with cold climate.

According Agoumi et al, 1999, the Maghreb, water resources are vulnerable to climate variations. The water and its management are already problems determine the future of this region, regardless of any climate change. The high sensitivity of watersheds to small differences in climate variables implies that the volume of water mobilized will be strongly affected by the decrease in runoff.

The Houérou, 1992 showed that if the increase in the CO₂ content of the atmosphere can increase yields of some crops in the Mediterranean region and especially in North Africa, this effect has to be counteracted by the risk reduction water availability and the accentuation of a dynamic already committed to increasing water shortages suffered by agriculture. The process of climate change will result in a northward shift of the Mediterranean bioclimatic zones, leading to North Africa with a rise in arid and desert areas.

Models of Rozensweig and Tubiello, 1997; Bindi and Moriondo 2005 forecast a drop in agricultural yields in North Africa, Increasing temperatures, declining rainfall and increased variability in fact implies a shift and a reduction in growth periods and an acceleration land degradation and the loss of productive land. Reduced water availability and increased needs are anticipated for rainfed and irrigated agriculture, caused by changes in rainfall patterns, increased evapotranspiration and rising sea level, accentuating the drought risk to critical periods of crop cycles.

2. Methodology

2.1. Model specification

Ensuring food security and food needs will continue to be one of the issues of News. It is urgent to develop new forecasting techniques that depend on reliable and objective variables. In this perspective, the production functions are planning and reference tool for policy makers, producers and consumers.

In this research we have built a production function of the Cobb douglas kind for wheat and rice, (the most dominant crop in this region). The Cobb-Douglas production function has already been used by several researchers in similar contexts (Griliches (1964), Wampach (1967), Cline (1970) Corbo and Dufour (1978)).

The estimation of a Cobb-Douglas production function is usually easy to carry for example by the least squares method and allows to raise several issues including that of biased estimates or the omission of variables. If we omit some variables and in the case of a negative correlation between omitted variables, through underestimate the variables included in the equation, in the case of a positive correlation with the other inputs on the end result, considers the elasticity coefficients assigned to these inputs.

The following model is based on an approach in terms of Cobb-Douglas production function. Production of wheat (wheat) is a function of four factors of production: arable land (Arable), the irrigated area (Irrig), temperature (Temp), and agricultural employment (Empl).

$$Wheat = f(Arable, Irrig, Temp, Empl) \quad (1)$$

According to the functions (1) and (2) our model is written

$$Wheat = \alpha + \beta Arable + \gamma Irrig + \delta Temp + \theta Empl \quad (2)$$

To study the impact of climate change on wheat, we use equations (2), equations that describe the relationship between wheat production and arable land, irrigated area, temperature and farm employment.

The evaluation of the effect of climate impact on the dynamics of long and short term, will be done via an MCE type of modeling (model error correction) or VAR (Vector Autoregressive). For each crop, the goal is to know its impulse response function following a climate shock. The data to use in the empirical analysis are from the World Bank database, the FAO and NOAA, these data are annual and cover the period which runs from 1980-2013.

2.1. Estimates

2.2.1. Impulse response function

The IRF methodology provides the ability to analyze the short-term dynamic relationships between variables in the model through the study of the dynamic response following a single shock suffered by the series.

In general, the analysis of a shock is to measure the impact of the variation of a share (innovation, shock pulse) on variables. For example from the model of wheat estimated for Tunisia:

$$\begin{aligned}
 Wheat &= \beta Arable_{t-n} + \gamma Irrig_{t-n} + \delta Temp_{t-n} + \theta Empl_{t-n} + \epsilon_{1t} \\
 Arable &= \beta Arable_{t-n} + \gamma Irrig_{t-n} + \delta Temp_{t-n} + \theta Empl_{t-n} + \epsilon_{1t} \\
 Irrig &= \beta Arable_{t-n} + \gamma Irrig_{t-n} + \delta Temp_{t-n} + \theta Empl_{t-n} + \epsilon_{1t} \\
 Temp &= \beta Arable_{t-n} + \gamma Irrig_{t-n} + \delta Temp_{t-n} + \theta Empl_{t-n} + \epsilon_{1t} \\
 Empl &= \beta Arable_{t-n} + \gamma Irrig_{t-n} + \delta Temp_{t-n} + \theta Empl_{t-n} + \epsilon_{1t}
 \end{aligned}$$

A change at a given time of ϵ_{1t} has an immediate impact on wheat_t then Arable_{t+1}, Irrig_{t+1}, Temp_{t+1}, et Empl_{t+1} for example if there is a shock on ϵ_{1t} at 1, we have the following impact:

At time t+1:

$$\begin{bmatrix} \Delta Wheat_t \\ \Delta Arable_t \\ \Delta Irrig_t \\ \Delta Temp_t \\ \Delta Prec_t \\ \Delta Empl_t \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

At time t+1:

$$\begin{bmatrix} \Delta Wheat_{t+1} \\ \Delta Arable_{t+1} \\ \Delta Irrig_{t+1} \\ \Delta Temp_{t+1} \\ \Delta Prec_{t+1} \\ \Delta Empl_{t+1} \end{bmatrix} = \begin{bmatrix} \beta & \gamma & \delta & \varphi & \theta & 1 \\ \beta & \gamma & \delta & \varphi & \theta & 0 \\ \beta & \gamma & \delta & \varphi & \theta & 0 \\ \beta & \gamma & \delta & \varphi & \theta & 0 \\ \beta & \gamma & \delta & \varphi & \theta & 0 \\ \beta & \gamma & \delta & \varphi & \theta & 0 \end{bmatrix} = \begin{bmatrix} \beta \\ \beta \\ \beta \\ \beta \\ \beta \\ \beta \end{bmatrix}$$

At time t+2 :

$$\begin{bmatrix} \Delta Wheat_{t+2} \\ \Delta Arable_{t+2} \\ \Delta Irrig_{t+2} \\ \Delta Temp_{t+2} \\ \Delta Prec_{t+2} \\ \Delta Empl_{t+2} \end{bmatrix} = \begin{bmatrix} \beta & \gamma & \delta & \varphi & \theta & \beta \\ \beta & \gamma & \delta & \varphi & \theta & \beta \\ \beta & \gamma & \delta & \varphi & \theta & \beta \\ \beta & \gamma & \delta & \varphi & \theta & \beta \\ \beta & \gamma & \delta & \varphi & \theta & \beta \\ \beta & \gamma & \delta & \varphi & \theta & \beta \end{bmatrix} \begin{bmatrix} \beta \\ \beta \\ \beta \\ \beta \\ \beta \\ \beta \end{bmatrix} = \begin{bmatrix} \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \\ \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \\ \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \\ \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \\ \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \\ \beta^2 + \gamma\beta + \delta\beta + \varphi\beta + \theta\beta \end{bmatrix}$$

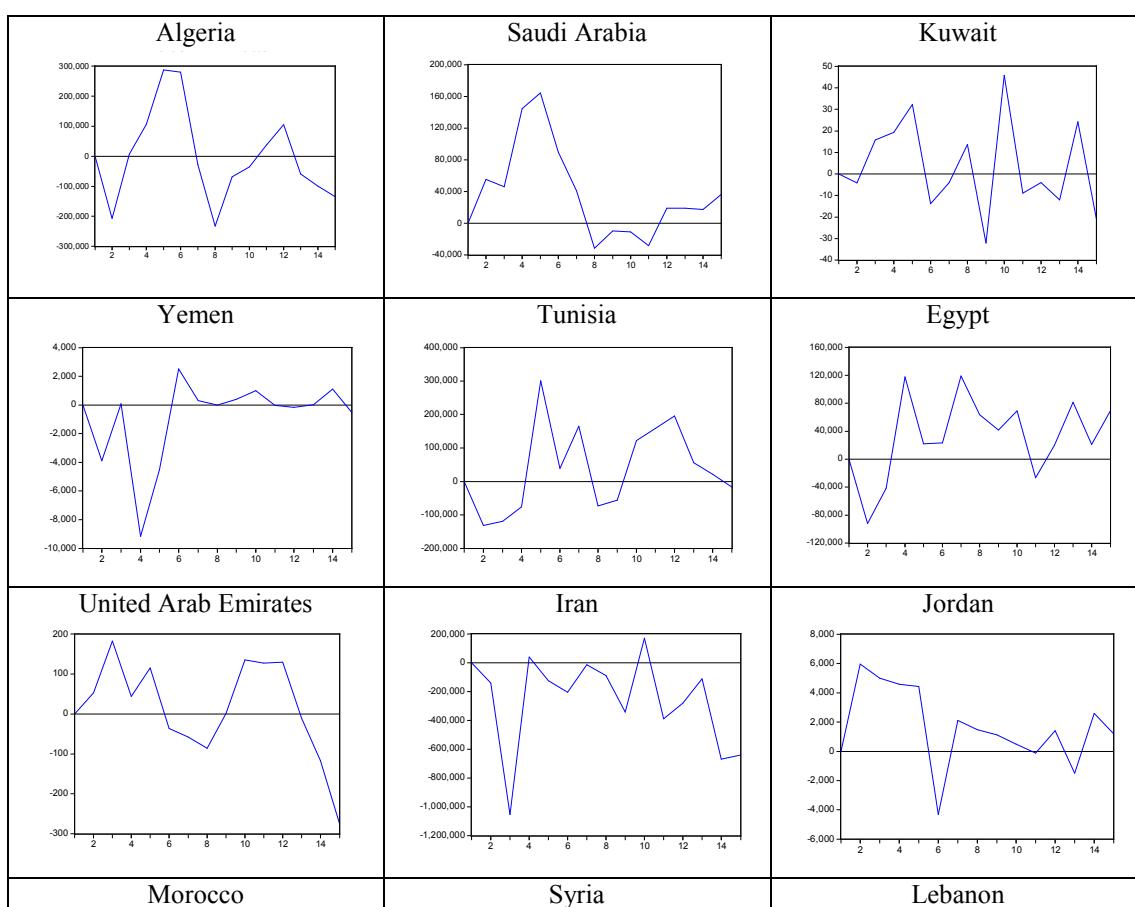
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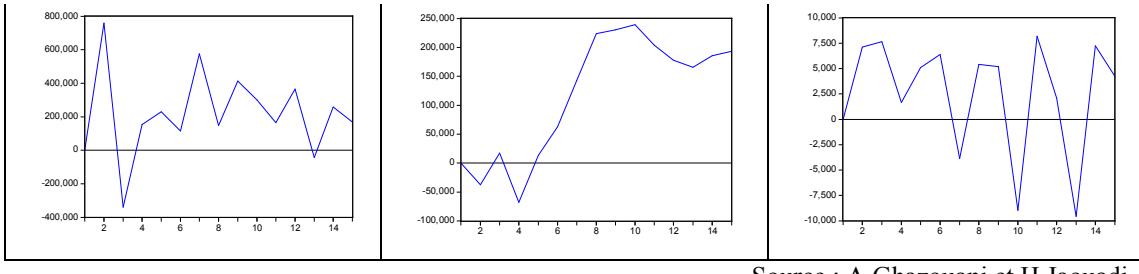
The various values thus calculated are the impulse response function.

The analysis of impulse think back functions in the following figures reveal to the temperature variation adversely affect wheat production in most countries in the MENA region.

Changes in the configuration temperatures increase the likelihood of poor short-term crops and long-term production cuts. Although there are gains in some countries of the MENA region, the overall impacts of climate change on wheat production should be negative, threatening the food security of countries in the region.

Table1. Impacts of rising temperatures on wheat production in MENA





Source : A.Ghazouani et H.Jaouadi

III.2. variance decomposition

The objective of the variance decomposition of the forecast error is calculated for each of the innovations contributing to the variance of the error. By a mathematical technique, we can write the variance of the forecast error at horizon h depending on the variance of the error assigned to each variable, and just bring each of these variances to the total variance for its relative weight in percentage.

if we take our model estimate for India, we interest for example at the two variables $wheat_{1t}$ and $temp_{2t}$, the variance of the forecast error for $wheat_{1t+h}$ can be written:

$$\sigma_{Wheat1}^2(h) = \sigma_{\varepsilon 1}^2 [m_{11}^2(0) + m_{11}^2(1) + \dots + m_{11}^2(h-1)] + \sigma_{\varepsilon 2}^2 [m_{22}^2(0) + m_{22}^2(1) + \dots + m_{22}^2(h-1)]$$

m_{ii} are the terms of the matrix M .

On the horizon h , the decomposition in percentage of the variance of innovations $wheat_{1t}$ on $wheat_{1t}$, is given by:

$$\frac{\sigma_{\varepsilon 1}^2 [m_{11}^2(0) + m_{11}^2(1) + \dots + m_{11}^2(h-1)]}{\sigma_{Wheat1}^2(h)}$$

And the decomposition in percentage of the variance of $wheat_{1t}$ innovations on $Temp_{2t}$ is given by:

$$\frac{\sigma_{\varepsilon 2}^2 [m_{22}^2(0) + m_{22}^2(1) + \dots + m_{22}^2(h-1)]}{\sigma_{Wheat1}^2(h)}$$

Interpretation of the results is important:

- If a shock on ε_{1t} does not affect the variance of the $temp_{2t}$ error whatever the forecasting horizon, then $Temp_{2t}$ can be considered as exogenous because $Temp_{2t}$ evolves independently ε_{1t} .
- If a shock on ε_{1t} strongly affects (see totally) the variance of the $temp_{2t}$ error, $Temp_{2t}$ can be considered endogenous.

In practice, the results are not as marked but show the contribution of each variable in the variance of the error.

The variance decomposition of the forecast error, allow evaluate for a several time horizons, the relative importance of different shocks on the fluctuations of the dependent variables of the model. In our case, we use this decomposition to measure the relative magnitude of impact of changes in precipitation and temperature on the fluctuation in the production of wheat and rice. The variance

decomposition of the forecast error allows determine which way and in which direction the impact of a shock has more importance.

Table 2. Part of temperatures in the variation of wheat production in the MENA region

Périod e	DZA	SA U	KW T	YE M	TUN	EG Y	AR E	IRN	JOR	MA R	SY R	LBN
1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2	3,40	0,57	0,07	1,63	9,78	2,72	0,73	0,25	8,81	14,2 9	0,18	15,4 6
3	5,13	0,55	0,92	1,31	10,3 5	2,84	7,34	11,9 0	12,6 1	14,2 3	0,15	26,5 7
4	5,84	1,78	1,75	5,79	11,8 6	5,74	6,94	9,87	14,6 4	14,2 4	0,48	26,0 5
5	11,1 5	2,81	3,58	5,27	28,0 6	5,46	8,68	8,92	16,0 6	14,8 5	0,44	24,0 8
6	21,6 8	2,69	3,86	5,27	24,7 0	4,45	8,51	8,88	18,0 4	13,9 1	0,61	24,6 4
7	23,1 4	2,28	3,57	4,96	26,1 4	6,23	8,22	7,52	18,4 3	18,3 1	1,52	23,8 9
8	21,7 9	2,01	3,62	4,36	25,5 1	6,29	8,41	7,24	18,1 3	17,8 9	3,02	26,2 7
9	23,1 1	1,81	4,47	4,16	25,1 7	5,96	7,15	7,43	17,4 5	19,2 1	3,63	28,1 1
10	27,7 8	1,67	6,60	4,11	25,8 5	6,21	8,53	6,87	16,9 3	20,0 1	3,73	29,3 3
11	27,4 9	1,59	5,53	4,10	27,5 5	6,15	7,69	7,47	16,8 5	20,0 7	3,50	32,4 1
12	27,1 2	1,51	4,38	4,06	28,9 9	5,96	6,32	7,31	16,9 6	21,1 7	3,34	30,3 9
13	27,6 2	1,44	3,98	4,01	27,8 5	6,55	3,27	6,56	17,0 4	21,0 4	3,25	33,8 3
14	28,2 0	1,37	3,47	3,99	27,1 0	6,39	2,04	7,63	17,5 1	21,5 5	3,30	34,2 0
15	27,7 2	1,32	3,19	3,90	26,6 9	6,57	1,89	7,77	17,5 4	21,7 2	3,38	33,1 0

Source : A.Ghazouani et H.Jaouadi

According to Table 1, we see that wheat production is heavily influenced by temperature variation in Morocco, Algeria, Tunisia, Lebanon and Jordan. The impact on temperatures respectively contributes

21.71%, 27.72%, 26.69%, 33.10% and 17.54% in explaining the variance of wheat production to a horizon of 15 years, the influence of the shock takes of importance as one moves away from the moment of its occurrence. Those countries with the exception of the Jordan belong to the Mediterranean climate with hot dry summers and wet and mild winters. This is a sensitive climate changes in temperature.

Other countries are in an arid climate with a permanent aridity throughout the year and precipitation and clouds are struggling to reach these areas because of the lack of long-term atmospheric disturbances. This climate is an obstacle to the development of animal and plant life. The result confirms the negative impact of rising temperatures on the production of wheat (Wheat poor resistance to water stress).

3. Discussion

Extreme events will lead to declines in crop yields. These phenomena will result in price increases for major agricultural commodities (wheat) and accordingly, they will cause a very substantial drop in consumption of cereals.

Soaring food prices which is observed in global markets since 2006 is likely part of a bullish long term trend and unstable because of a mismatch between demand and supply of food products, imbalance exacerbated by erratic and more extreme weather. With only 6% of the world population, the MENA region accounts for a third of purchases of wheat in the world.

Recent increases in climate variability may have affected crop yields in various countries since the mid-1980s causing a large inter-annual variability of wheat yields. Changes in the annual performance variability of wheat would a high-risk culture. Even cultures middle latitudes might suffer at very high temperatures in the absence of adaptation.

Short-term extreme temperature changes can be critical, especially if they coincide with development milestones. Only a few days of extreme temperatures (over 32 ° C) at the flowering stage of many crops can significantly reduce performance.

Crop response to changes in growth conditions may be non-linear and subject to combinations of stressors that affect their growth, their development and potential output. In the short term high temperatures can affect the enzymatic reactions and gene expression. In the longer term, they will impact on carbon assimilation and therefore the growth rate and the potential return. The impact of high temperatures on the final yield may depend on the stage of crop development.

Wollenweber et al (2003) found that plants have periods of warming as independent events and the critical temperatures of 35 ° C for a short period around flowering have had severe effects on yield reduction.

The review of literature of Wheeler et al (2000) suggest that temperature thresholds are well defined and highly conserved between species, especially for processes such as flowering and grain filling. In the mid 30 rice grains have become sterile due to high temperatures and similar temperatures can lead to reverse the effects of vernalization for wheat.

In all cases and in all regions, the events that are now considered extreme would be less unusual in the future. The impacts of extreme temperature events can be difficult to separate from those of the drought. However, exceeding the current temperature thresholds alter plant physiology and grain and will be devastating to yields.

With more than 10 million tonnes / year, Egypt is the world's largest wheat importer, followed by the MENA Region by Algeria, Iran, Yemen, Morocco, Iraq, etc. With only 6% of the world population, the region accounts for a third of purchases of wheat in the world.

From Morocco to Egypt, consumption is the highest in the world: 100 kilos of wheat per capita per year, double the European Union, three times the rest of the world. soil quality, climate, water shortages and population growth are factors that plunge the region into a hyper cereal addiction.

The world consumes more food than before. FAO data indicate that dietary energy measured in kilocalories per capita per day has been increasing globally. The per capita food consumption worldwide increased to 2,800 kcal per capita per day in the late 1990s from 2,360 kcal per capita per day in the mid-1960s consumption by FAO amounted to 2015-2940 kcal per capita per day.

Food consumption in the MENA region has also increased, particularly for food products such as vegetables, meat, starches and seafood. The issue of food security is of importance as never before, food prices are on an uptrend. Rising food prices, it is difficult for the MENA region, which is dependent on imports to meet its domestic demand.

There are several factors that determine food consumption in the region. The population of the MENA region reached 214 million in 2010, against 175 million in 2000. In other words, the region has added about 40 million at the base of the population during the last decade. This is also reflected by 4 million extra mouths to feed each year.

The increase in population poses a challenge for the MENA region, which accounts for nearly 50% of its imports by food needs. Rapid urbanization and the growth of the income level of the population in the MENA region leading to greater food consumption (due to the positive correlation between income and food consumption).

The following table shows the inequality between countries in the region in terms of loss of arable land per capita. Palestine, Lebanon, Syria and Jordan are the most severely affected because everyone has seen its share of arable land decreases by 54%, 26.6%, 24.8% and 15%.

Table 3. Change of arable land between 1962 and 2013

countries	variation
Qatar	1311
Kuwait	960
United Arab Emirates	650
Saudi Arabia	164,482759
Oman	88,5
Mauritania	68,5393258
Bahrain	60
Morocco	22,0789074
Algeria	18,9873016
Egypt	12,5359638
Iraq	7,52688172
Libya	0,58479532
Iran	-0,74716478
Yemen	-1,96386489
Israel	-7,50809061
Tunisia	-7,96774194
Jordan	-15,0735294
Syria	-24,8064516
Lebanon	-26,6666667
Palestinian territories	-54

Conclusion

Climate change is already having a big impact on food security and agriculture in general through the increase of the unpredictability of weather patterns and the increase in the intensity, frequency and duration of extreme weather events.

Sets the MENA region will be seriously affected by these extreme events. Most of these producer countries are facing a shortage of natural resources. They often miss their knowledge necessary on the possible options of adaptation of their production systems, in addition to AC, they have weak capacity to take risks.

Mitigating climate change, improving food security and protect natural resources and vital ecosystem services requires a shift to more performing agricultural production systems, with a stronger production to economic shocks and climate variability, more stable and less variable.

To ensure that these resources are efficiently managed, a more resilient and productive agriculture requires a major change in genetic resource management practices, soil nutrients, water and land. Accomplishing these changes requires huge changes in financial mechanisms, policies, legislation and local and national governance

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Steroid Nuclear Receptor Coactivator 2 Controls Immune Tolerance by Promoting Induced Treg Differentiation via Upregulating Nr4a2

Wencan Zhang¹, Xu Cao², Xiancai Zhong¹, Hongmin Wu¹, Mingye Feng², Yousang Gwack³, Isakov Noah⁴ and Zuoming Sun^{1*}

¹ Department of Immunology & Theranostics, Arthur Riggs Diabetes & Metabolism Research Institute, Beckman Research Institute of the City of Hope, Duarte, CA, 91010

² Department of Immuno-Oncology, Beckman Research Institute of the City of Hope, Duarte, CA, 91010

³ Department of Physiology, David Geffen School of Medicine, UCLA, Los Angeles, CA, 90095

⁴ Department of Microbiology, Immunology and Genetics, Ben Gurion University of Negev, Bear Sheva, Israel.

* Corresponding author Zuoming Sun (zsun@coh.org)

Abstract

Steroid nuclear receptor coactivator 2 (SRC2) is a member of a family of transcription coactivators. While SRC1 inhibits the differentiation of regulatory T cells (Tregs) critical for establishing immune tolerance, we show here that SRC2 stimulates Treg differentiation. SRC2 is dispensable for the development of thymic Tregs, whereas naïve CD4⁺ T cells from mice deficient in SRC2 specific in Tregs (*SRC2^{f/f}/Foxp3^{YFP-Cre}*) display defective Treg differentiation. Furthermore, the aged *SRC2^{f/f}/Foxp3^{YFP-Cre}* mice spontaneously develop autoimmune phenotypes, including enlarged spleen and lung inflammation infiltrated with IFNγ-producing CD4⁺ T cells. *SRC2^{f/f}/Foxp3^{YFP-Cre}* mice also develop severer experimental autoimmune encephalomyelitis (EAE) due to reduced Tregs. Mechanically, SRC2 recruited by NFAT1 binds to the promoter and activates the expression of *Nr4a2*, which then stimulates Foxp3 expression to promote Treg differentiation. Members of SRC family coactivators thus play distinct roles in Treg differentiation and are potential drug targets for controlling immune tolerance.

Teaser

SRC2 controls the scale of immune responses via activating *Nr4a2* gene to promote CD4⁺Foxp3⁺ iTreg differentiation.

Beneficiation of Pulp and Paper Mill Sludge for the Generation of Single Cell Protein for Fish Farming

Lucretia Ramnath

Abstract— Fishmeal is extensively used for fish farming but is an expensive fish feed ingredient. A cheaper alternate to fishmeal is single cell protein (SCP) which can be cultivated on fermentable sugars recovered from organic waste streams such as pulp and paper mill sludge (PPMS). PPMS has a high cellulose content, thus is suitable for glucose recovery through enzymatic hydrolysis but is hampered by lignin and ash. To render PPMS amenable for enzymatic hydrolysis, the PPMS was pre-treated to produce a glucose-rich hydrolysate which served as a feed stock for the production of fungal SCP. The PPMS used in this study had the following composition: 72.77% carbohydrates, 8.6% lignin, and 18.63% ash. The pre-treatments had no significant effect on lignin composition but had a substantial effect on carbohydrate and ash content. Enzymatic hydrolysis of screened PPMS was previously optimized through response surface methodology (RSM) and 2-factorial design. The optimized protocol resulted in a hydrolysate containing 46.1 g/L of glucose, of which 86% was recovered after downstream processing by passing through a 100-mesh sieve (38 μm pore size). Vogel's medium supplemented with 10 g/L hydrolysate successfully supported the growth of *Fusarium venenatum*, conducted using standard growth conditions; pH 6, 200 rpm, 2.88 g/L ammonium phosphate, 25°C. A maximum *F. venenatum* biomass of 45 g/L was produced with a yield coefficient of 4.67. Pulp and paper mill sludge hydrolysate contained approximately five times more glucose than what was needed for SCP production and served as a suitable carbon source. We have shown that PPMS can be successfully beneficiated for SCP production.

Keywords— pulp and paper waste, fungi, single cell protein, hydrolysate.

Lucretia Ramnath is with the in University of KwaZulu-Natal, South Africa (e-mail: ramnathl@ukzn.ac.za).

Machine Learning as an Efficient Tool to Define Microstructure of Fibrillar Biomolecules by Means of Dynamic Rheometry

Karina Núñez^{1,2}, Cristian Velazco², Julia Guerrero², María Asensio², Juan Carlos Merino^{1,2}.

Department of Condensed Matter Physics, University of Valladolid, Paseo de Belén, 7, 47011
Valladolid, Spain

Foundation for Research and Development in Transport and Energy (CIDAUT), Parque
Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos 2, 47051 Valladolid, Spain

Corresponding author: karinacarla.nunez@uva.es

Abstract

In efforts to better understand complex bio-based raw materials, a method of characterising the molecular weights of collagen chains based on rheological measurements and artificial intelligence has been investigated. It is well known that high molecular weight fibrillar proteins, such as collagen, represent a real option for making advanced biological and structural materials; however, although they possess a triple helix fibrillar structure that confers excellent mechanical properties, it is not possible to accurately measure the size of these chains to design new materials. Especially when these proteins are in their native state. The difficulty lies in the particular sensitivity of these biomolecules to be hydrolysed or denatured in the presence of solvents or high temperatures. Current PM measurement methods (size exclusion chromatography, electrophoresis, mass spectroscopy, etc.) represent destructive methods that fragment the protein and do not give a true value of the measurement. Currently, the main uses of collagen are in the food, and biomedical industries, where low molecular weights are required, so thermomechanical and chemical processes are applied to native collagen, and current methods of characterising the resulting structures are sufficient. However, to exploit the advantages of high native molecular weights in higher value-added structural applications, no suitable characterisation tool exists. Therefore, the aim of this research has been to study how to obtain the molecular weights and their distributions in collagen by non-destructive rheological methods and with the knowledge generated in recent years on machine learning and artificial intelligence techniques based on mathematical models. The use of these tools will allow adjusting the experimental values to the expected theoretical curve, obtaining the expected values where the experimental part is not able to produce information due to the limitations of the experiment; thus, creating a predictive and theoretical reliable method of microstructural characterisation of polymeric collagen chains; which in turn will allow further progress in the development of new biomaterials. The use of the rheometric technique to measure molecular weights has been widely reported for synthetic macromolecules such as conventional polymers. It is a method based on translating the molecular motions of individual chain segments into Gaussian molecular weight distributions in a melt-based assay. The challenge has been to achieve the conditions of maximum molecular mobility of collagen in an oscillatory test in a very narrow temperature window to avoid damage to the structure. Corrections and predictions of the rheological behaviour of these materials have been applied using artificial intelligence

techniques. The results obtained are promising and provide a good approximation to the quantitative characterisation of the molecular weights of high PM collagens and provide an important design tool for further progress in the creation of higher value materials: packaging, structural materials for the transport and construction sectors, etc.

Keywords: Collagen, molecular weight, dynamic rheometry, artificial intelligence tools

Indigenous Engagement: Towards a Culturally Sensitive Approach for Inclusive Economic Development

K. N. Penna, E. J. Hoffman, T. R. Carter

Abstract—This paper suggests that cultural landscape management plans in an Indigenous context are more effective if designed by taking into consideration context-related social and cultural aspects, adopting people-centred and cultural-based approaches for instance. In relation to working in Indigenous and mining contexts, we draw upon and contribute to international policies on human rights that promote the development of management plans that are co-designed through genuine engagement processes. We suggest that the production of management plans that are built upon culturally relevant frameworks leads to more inclusive economic development, a greater sense of trust, and shared managerial responsibilities. In this paper, three issues related to Indigenous engagement and cultural landscape management plans will be addressed: (1) the need for effective communication channels between proponents and Traditional Owners (Australian original Aboriginal peoples who inhabited specific regions), (2) the use of a culturally sensitive approach to engage local representatives in the decision-making processes, and (3) how design of new management plans can help in establishing shared management.

Keywords—Culture-Centred Approach, Holons' Hierarchy, Inclusive Economic Development, Indigenous Engagement.

I. INTRODUCTION

THE Pilbara is a large, dry and lowly populated region in the north of Western Australia. The region is known for its Indigenous peoples and their enduring connection to land and culture, its rich cultural heritage, unique biodiversity, and its substantive mineral resources, particularly iron ore. The Pilbara region generates more than half of the value from West Australia's annual resource production. Ongoing development to sustain and grow production from the region is key to the economic prosperity of Western Australia. However, resource extraction and development in the region have historically failed and remain challenged in achieving balance between land development impacts and preservation of its cultural landscape assets. Similarly, the aspirations of commercial operators and communities to achieve shared benefit from developments have failed to be truly realised.

Rio Tinto are one of the world's leading producers and exporters of iron ore. In the Pilbara region of Western Australia, Rio Tinto own an integrated portfolio of iron ore assets: an integrated network of 16 mines, four independent port

K. N. Penna is a professor of the Centre for Advanced Studies of Integrated Conservation, Brazil, and an Indigenous Landscape Specialist of the Rio Tinto Iron Ore in the West Pilbara, Australia (corresponding author, phone: +61 448 300 034; e-mail: karla.penna@riotinto.com).

E. J. Hoffman is the Cultural Heritage Manager, Heritage and Traditional

terminals, a 1,700-kilometre rail network and related infrastructure [17] designed to allow the company to respond rapidly to changes in market demand for iron ore. Rio Tinto continually invests in its operations in the Pilbara, to deliver greater efficiency, lower production costs and improved health, safety, community and environmental performance and sustain and grow its production to meet market demand.

In 2020, following the tragic destruction of culturally significant rock shelters in Jukkan Gorge, and the deep impact of this on the Puutu Kunti Kurrama and Pinikura people, other Traditional Owners of the lands on which Rio Tinto operates, Indigenous Peoples and its own employees and other stakeholders in Australia and beyond, Rio Tinto was forced to confront legacy and underlying issues of the way it had approached its economic developments and Indigenous engagements. Following this incident, Rio Tinto committed to listening, learning, showing greater care, and taking new approaches designed collaboratively with Indigenous Peoples to manage and protect cultural heritage and social values in its mine developments and operations for the shared benefit of all. This change requires theoretical, methodological and practical shift in the way the company approaches Indigenous engagements. A case study highlighting how this change is occurring at Rio Tinto is presented here.

II. METHODOLOGY: SETTING THE STUDY

A. Social Ethnography

This study applied a social ethnographic approach as a qualitative methodology, used to emphasise the importance of understanding the meanings of human behaviour and the social-cultural context of social interaction. Social ethnographies promote the development of empathetic understanding based on subjective experience, where the main purpose of the study is understanding the connections between personal perceptions and the focus group behaviour. This approach is helpful for understanding social relations and cultural practices through critical analysis [1]. Gaining knowledge from the context and understanding phenomena through the meanings local people ascribe to them, is an essential feature of high-quality consultations.

Owners Partnership of Rio Tinto in Western Australia (e-mail: Eloise.hoffman@riotinto.com).

T. R. Carter is a Senior Advisor, Communities and Social Performance Rio Tinto, Perth, Australia, in the West Pilbara, Western Australia (e-mail: tonya.carter@riotinto.com).

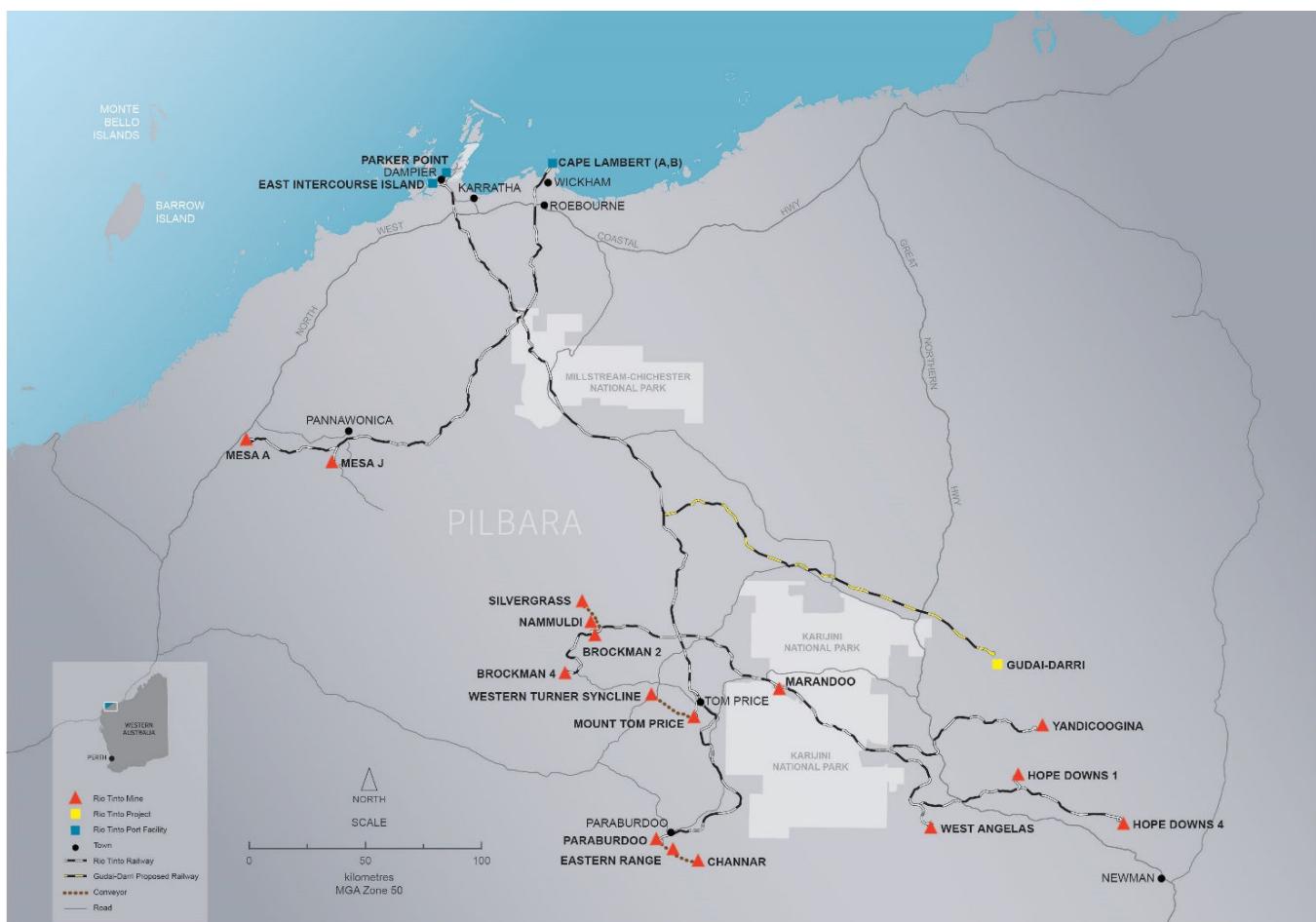


Fig. 1 Map of Western Australia and the Pilbara Region [4]

Field techniques such as participant observation, in-depth conversations, field notes, and case studies were applied to portray the local Indigenous world as understood by themselves, trying to avoid Westerner pre-conceived social frameworks of thinking. The chosen approach demanded a high level of cultural sensibility to deal with the multidisciplinary aspects of local people and their contexts [3].

B. Ethnographic Methods

The aim was to use ethnographic methods to conduct a relevant, meaningful, understandable, useful, reliable, and believable consultation, which led to a thick description of the context. Thick descriptions are comprehensive, holistic portrayals of the social and cultural dimensions of the context [2]. They provide a level of detail that allows readers to draw informed conclusions and compare one context to others. The ethnographic methods used in the study were:

- Semi-structured interviews: They are conversations with a purpose, helpful for understanding and putting into a larger context the interpersonal, social and cultural aspect of the environment [2]. Semi-structured interviews are guided by a set of basic questions and issues to be explored. With Indigenous people in Pilbara, the open-ended informal conversations consisted of direct references from people concerning their experiences, opinions, feelings, and

knowledge.

- Participant Observation: The data from this type of observation emerge in the field from direct contact with the focus group, and encompass detailed descriptions of day-to-day activities, participants' behaviours, and the full range of human interactions that can be part of their social experiences [3]. Observational data portray the big picture of the context, providing depth and detailed data. Also, for skilled observers, the observations enable reading of nonverbal messages, and what cannot be said in interviews.
- Life Histories: this method relies on gathering life experiences from the focus group participants. By generatively listening local people stories, the researcher can understand particular aspects of the context, understanding cultural insiders' perspectives [4].
- Problem-oriented ethnography: this is a focused ethnographic approach directed to specific question [5]. For the case of Pilbara Indigenous peoples, the focus was the effects of the mining project on local social surroundings.
- Ethnology (cross-cultural comparison): this is a technique employed by cultural anthropologists in order to understand the similarities and differences among cultures [6]. This rich comparison was helpful to better understand

the processes of adaptation of the local culture in facing the cultural landscape changes.

III. THEORETICAL FRAMEWORK

A. Culture-Based Approach

This study was conducted within the framework recommended by the Policy Guidance of Heritage and Sustainable Development Goals [7]. This guidance states that human-rights based and culture-based approaches are essential for effective cultural heritage management, where respecting every people's cultural identity and freedom is fundamental to facilitate intercultural dialogue, foster participatory governance and political inclusion.

The human-rights based approach recognises the importance of Indigenous knowledge and practices in preserving biodiversity and ensuring the protection, rehabilitation and sustainable use of the land. This approach supports and encourages the active involvement of Indigenous peoples in environmental negotiations for exercising their right to sovereignty and to free, prior and informed consent [7].

The culture-based approach understands cultural heritage values (aesthetic, environmental, social, cultural and economic) as inseparable, entangled and interrelated. For this reason, a cultural landscape constitutes a living heritage where culture, nature and communities connect in a physical and spiritual way [8]. This interrelationship is usually ignored, neglected or misunderstood by the predominant Western perspective, which tends to separate the cultural and natural domains [9].

B. Cultural Sensitivity and Cultural Awareness

Although most document analysis conducted for this study approach the concepts of Cultural Awareness and Cultural Sensitivity as being the same, it is important to clarify the different practical applications between these two concepts.

Cultural awareness is understanding the differences that exist between different cultures. This involves cultural diversity recognition, respect and potentially social or technical involvement in actions that can nurture the unique cultural identity of a people.

Cultural Sensitivity is the use of this consciousness in effective communication with members of another cultural group. This involves trust and credibility building, a certain level of intimacy to establish strong, long-lasting relationships, interpersonal skills to understand and safely meet others' needs, expectations and inherent rights [10]. It means working from the cultural perspective of the other person, not from your own.

Becoming culturally aware of the social and cultural differences that exist between cultures is not sufficient to reach a full understanding of a given people and its context. It also means being prepared to guard against imposing your own behaviours, beliefs and actions as the norm for developing plans, policies and projects accepting.

IV. CONTEXTUAL BACKGROUND

The mining development project to which this new engagement approach is being applied has been in feasibility

study since late 2019, with the change in engagement approach introduced in late 2020. The potential ore from the project's development would expand operations to sustain production from an existing mining operations hub for the next 15 to 20 years as ore from the other mine in the hub are depleted. The project is currently designed as mining areas along a range and a crusher and conveyor to transport the ore to the existing mine processing plant and rail infrastructure.

The project represents an important part of the future of Rio Tinto's production profile through sustaining annual output from the mining hub into the company's regional production. Additionally, the project development would also sustain the viability of a proximate regional town primarily operated by the company through maintaining the existing residential workforce levels in the town.

V. FORMER ENGAGEMENT STRATEGY

Rio Tinto's former engagement strategy in the Pilbara was underpinned by methods built from archaeological processualism and ethnoarchaeology approaches and the associated compliance framework defined in West Australian heritage law. The approach had several underlying issues but core to these was that it overlooked or ignored the social-cultural context of the development resulting in a development approach that focused solely on protection or mitigation of individual objects or places based on a scientific concept of these places value.

No consideration was given to non-place bound aspects of socio-cultural values in land management or development. This engagement strategy has underpinned the last few decades of Rio Tinto Iron Ores Indigenous Engagement in the Pilbara with only minor modification or devices from this approach during this time. During this time, company culture placed much emphasis on business performance and not enough focus on our relationships with the Indigenous communities on whose lands we operate. The new approach came at the expense of recognizing the gaps in this approach to meet the aspirations of the regions indigenous peoples, communities, and our business to achieve mutually beneficial and economically inclusive development.

As a company, Rio Tinto has made commitments to its people, Traditional Owners and the general public to partner on developing best practice approaches for Indigenous Engagement. Authority has been given to its people to rebuild its approaches and ensure Indigenous voices are heard right across our organisation.

VI. TRANSFORMING CONVENTIONAL MANAGEMENT IN A COLLABORATIVE PROCESS

A. The Conventional Management System

By analysing the outcomes reported in documents and existing assessments in Western Australia, both private and public, the current conventional design for cultural heritage management does not seem to guarantee the effective involvement of traditional communities an active part in a shared management system. Firstly, the majority neglects the

fact that social, cultural and environmental policies are designed for addressing human needs, and thus should adopt a broader approach in order to cover multidimensional societal aspects. Second, in existing instruments and plans, traditional communities and their cultural traditions and knowledge are a part of, not the centre of, policies. In addition, the conventional management perspective generally develops from the global to the local, not vice-versa, where attending to inhabitants' demands comes after economic and political matters. This means that often context-related sociocultural factors are not, or are only partially, considered.

In general, although Indigenous people are heard, it is notable that not all professionals are ready to talk to or interview Traditional Owners in the field. Many professionals are not prepared to fully understand peoples' needs given the lack of a culturally sensitive approach for engagement. This creates a communication barrier between those professionals and the Indigenous people. This is problematic as these professionals are responsible to report peoples' needs to the industry or government. As consequence, the holistic picture that would emerge from the engagement effort during field surveys and assessments can be compromised.

Along with norms and decontextualised public policies, there are real-life examples emerging from new, effective practices and approaches in addressing socio-environmental pressures. New management designs have been proven to be highly effective in proper preserving local people's values. These designs adopt a holistic, integrated approach to the preservation of the cultural landscape values and consider the spiritual connection between traditional people and their land [14]. Usually, shared management is a key factor to achieving successful common initiatives.

B. Shared Management

Globally, finding ways to develop better social and cultural heritage management structures has been a top priority on the agenda of institutions, planners and professionals. In that sense, shared management [11] has emerged as a useful managerial approach used to guide the engagement and discussions between Indigenous people and Rio Tinto representatives about mining projects.

Focusing on reaching inclusive economic development, Rio Tinto has initiated with Traditional Owners a process of designing a shared management plan for identification, assessment, and mitigation of impacts caused by the mining projects on local cultural landscape values. Inclusive economic development is a development that favours a people-centred economy, making macroeconomic growth and equity compatible, as measured in terms of employment, income, and welfare.

First outcomes from engagement consultation using a culturally sensitive approach have shown the amplification of social participation and integration of local representatives' in participatory governance. The strengthening of participatory channels and engagement forums from the second semester of 2021 was notable, incorporated increasing local social actors in debates and decision-making processes in a more effective and

productive way than in the past years. Difficult discussions and negotiations resulted from this process, which is expected when different interests have to be reconciled to reach one single common goal in a complex context. However, the respectful, safe, open, flexible negotiation environment created, led to collaborative, rather than adversarial, behaviour among Traditional Owners. This is an ongoing process of co-constructing a new system to manage the mining impacts on the landscape. The creation of this new fruitful negotiation channel has been essential to reach a joint management design that is socially sustainable, economically inclusive, and environmentally responsible. That is the fundamental base of successful shared management.

C.A Different Way to Understand Hierarchy: The Holons Relationship

The complexity of social systems requires non-linear design methods to absorb and comprehend the subjective, immaterial aspects of the cultural landscape values. The expanding concept of heritage and the increased importance of how heritage places relate to their surroundings mark an important shift in thinking how heritage places have to be managed. For cultural landscape management, mining development activities cannot be isolated from social changes that will be occurring on the local society dynamic. For this reason, the "social denomination" has been added to cultural heritage management plans worldwide, to allow a wider scope of heritage perspectives, leading to include many more players or stakeholders being involved in its management. Within this context, the projects' approval process for the Pilbara region requires the development of a comprehensive social and environment impact assessment – named Social Surroundings - ruled by the Environmental Protection Authority (EPA) in Western Australia. According to the Environmental Protection Act (Subsection 3.2), "the social surroundings of man are his aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by his physical or biological surroundings" [12].

The approval process also requires the development of a Social and Cultural Heritage Management Plan - SCHMP, a tool presenting an assessment of the potential impact of the proposed mining activity on the cultural landscape values. This plan includes a mitigation strategy to manage, safeguard, monitor, assess, improve and promote the local natural and cultural values. For Indigenous territories, it is important that this plan outlines measures to be taken before, during and after a project development activity to manage and protect Aboriginal cultural heritage in the activity area [13]. Inclusive economic development – including a healthy relationship between local people and project developers, and capacity build to improve participatory governance - is the core goal of the SCHMP.

For reaching an effective integral management system of cultural landscapes in Pilbara, Rio Tinto's heritage and community and social performance teams are developing an integrated managerial system connecting the local SCHMPs - designed for each specific project and its respective landscape -

with a regional Cultural Heritage Management Plan - CHMP. For reaching an effective integral management system of cultural landscapes in Pilbara, Rio Tinto's heritage and community and social performance teams are developing an integrated managerial system aiming at connecting local SCHMPs - designed for each specific project and its respective landscape - with a regional CHMP. The CHMP provides the framework for a broader, holistic, shared management to be done in agreement with Indigenous People, ensuring an inclusive, coordinated approach, aligned with the local legal framework, to local SCHMP.

The holons' hierarchy was adopted for designing the interrelationship between an CHMP and a proposed SCHMP. According to Koestler [14], holons are self-reliant, independent entities that can be considered a self-complete whole, an autonomous unit. At the same time, holons can be viewed - within a hierachic structure for example - as dependent of other whole, as a subsystem within a larger system. In this context, a holon can be simultaneously an evolving, self-organised, dissipative structure while also a part of a greater system composed of other holon(s).

The SCHMP has the Social Surroundings as its internal independent holon. The Social Surroundings work as a dissipative form that interacts dynamically with the SCHMP. A dissipative system is an open system which is operating out of, and often far from, equilibrium in an environment with which

it exchanges information. Dissipative systems stand in contrast to conservative systems as they may be affected by the whole system context [15]. The dissipative system is a concept applied in general in mathematics and physics, that was adapted in this case to the social field. The subjective nature of Social Surroundings led to an innovative design of its structure, where its canonical form was transformed into an open system – an inverted circle.

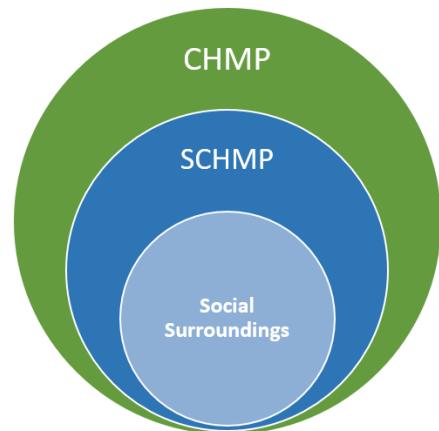


Fig. 2 CHMP and SCHMP Holonic Hierarchy [18]

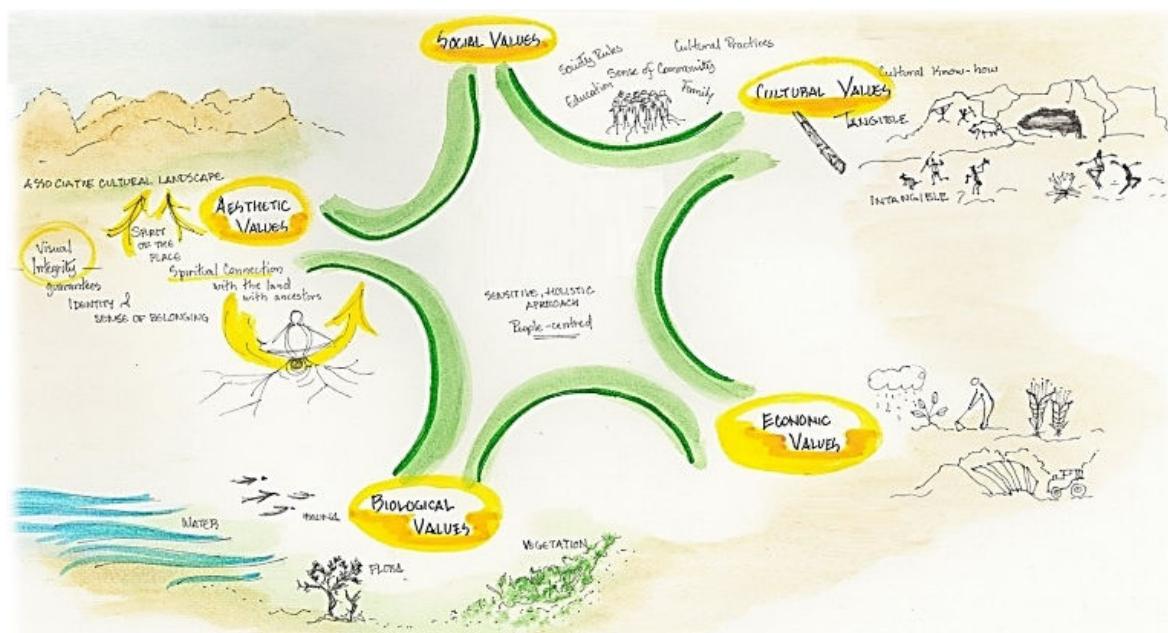


Fig. 3 Transformed form of the conventional holon structure: inverted circle [18]

The sketched map shown in Fig. 3 was used during the engagement workshops with Yinhawangka people to assist in understanding and identifying cultural landscape values of their country.

As a dissipative holon, the Social Surroundings can have a strong relationship with the larger whole system (CHMP-SCHMP) to a point that, when the SCHMP's point of focus

moves, the whole hierarchical structure moves as well, providing the clear perception of how the three holons can interact in a co-dependent way to each other [16]. This property ensures that even as autonomous holons, each one can provide context for the proper functionality for the larger whole.

VII. FINAL NOTE

This is an ongoing study leading to a SCHMP system design and implementation based on comprehensive and credible information. This whole management system aims to be open, interactive, dynamic, holistic and should contain detailed descriptions of all project stages; analysis of major processes as well as participatory actions and monitoring based on constant engagement with the Traditional Owners.

VIII. CONCLUSION

The Pilbara landscape is a common Australian heritage and as such its landscape conservation encompasses a broad range of values including cultural heritage places, flora and fauna, visual integrity, natural habitats, water catchments and the spiritual significance of material and immaterial values like yinda (water) to local people. Therefore, it is important that environmental protection and cultural heritage preservation tools such as the SCHMP and CHMP, are produced in a joint effort between local native title holders, industry and the public sector - generating agreements, protocols and interconnected actions, based on a shared management system. It is moving beyond speeches and remediative actions of conservation towards healing and caring about the country.

The development and implementation of plans and policies under new management designs would be a breakthrough for the implementation of the purposes of manifestos, charters and local and international discussions published around the world. The most important point is not to do the same things better, but to do different things for different situations. Each social scenario, even if adopting the same management design, requires a specific local approach that can take into consideration context-related factors generating impacts on a certain development envelope.

ACKNOWLEDGMENT

The authors acknowledge the Yinhawangka Traditional Owners and elders who were the focus group of this case study. These traditional communities look after their country with much care, and kindly over the years have shared with professionals and academics their stories tracing back thousands of generations. The authors respect and recognize Yinhawangka unique culture and anticipate that not just this paper but a whole work that has been developed by them in protecting local irreplaceable cultural landscape values can allow Yinhawangka people to stretch its tradition forward into the future as a way to promote their intergenerational knowledge transmission.

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- Karla N. Penna** (corresponding author) Architect, Anthropologist and Urban Planner, Brazilian and Australian citizen, Post-graduate in Heritage Conservation (2001) and in Heritage Management (2007) by the Centre of Advanced Studies in Integrated Conservation - CECI (Cathedra UNESCO), Brazil, and in Project Management (2021) by Curtin University, Perth, Australia; Master in Cultural Heritage Studies (2013) by Curtin University; PhD in Education and Cultural Anthropology (2019) by Murdoch University, Perth, Australia.
 She served as the Director of the Department of Cultural Heritage in Sao Luis, Brazil (1997-2006), Consultant for the same department from 2007 to 2008) and as a UNESCO Consultant for World Heritage Sites in different countries in Latin America and Europe from 2008 to 2021. She is currently working as a Professor for the CECI Preservation Training Centre since 2008 and as a Specialist in Indigenous Landscapes for Rio Tinto Iron Ore since 2021 in Perth, Western Australia. She is the author of 26 articles and book chapters and three books that can be found at <https://www.researchgate.net/profile/Karla-Penna/publications>.
- Dr. Penna is a member of ICOMOS, UNESCO, LASA (Latin American Studies Association), ENCATC (European Network of Cultural and Art Management and Policy and the International Transformative Education Research Network (Nepal).
 She is the President of CECI's Scientific Committee, and expert reviewer for various international institutions and journals such as the Green Lines Institute of Heritage and Sustainable Development (Portugal); the World Academy of Science, Engineering and Technology (France), International Journal of Art and Cultural Management (Canada), and the Iron Bridge (UK).
- Eloise J Hoffman** Anthropologist, New Zealand and Australian Citizen, Master of Arts in anthropology and archaeology (2016) and Bachelor of Arts Honors anthropology (2013) by The University of Auckland, Auckland, New Zealand.
 She is the Cultural Heritage Manager for Rio Tinto Iron Ore's Cultural Heritage Management team in Perth, Western Australia and prior to this a number of cultural heritage management and community development roles within other parts of the Rio Tinto group within Australia. She has co-authored journal publications on her post graduate research and works undertaken as part of her cultural heritage management roles within Rio Tinto which can be found at <https://orcid.org/0000-0002-7015-1475>.

Ms. Hoffman is a member of the New Zealand Archaeological Association, the Australian Archaeological Association, the International Council for Archaeozoology, and the International Council on Mining and Metals.

Tonya R. Carter, Environmental Scientist, post graduate qualification in Policy and Law, specialised in mining and environmental law, University of Western Australia.

She currently holds the position of Senior Advisor, Community and Social Performance, Rio Tinto Iron Ore, Pilbara Western Australia. Her career spans over 15 years in environmental approvals within both private and public sectors and she has worked in policy and legislative reform.

Ice-Jam Flood Hazard and Risk Assessment and Mapping

Karl-Erich Lindenschmidt¹, Apurba Das¹, Joel Trudell² and Keanne Russell²

¹ Global Institute for Water Security, School of Environment and Sustainability, University of Saskatchewan, 11 Innovation Boulevard, Saskatoon, Saskatchewan, Canada, S7N 3H5

² Regional Municipality of Wood Buffalo, 9909 Franklin Avenue, Fort McMurray, Alberta, Canada, T9H 2K4

*karl-erich.lindenschmidt@usask.ca, apurba.das@usask.ca, Joel.Trudell@rmwb.ca,
Keanne.Russell@rmwb.ca*

Abstract

In this presentation, we explore options for mitigating ice-jam flooding along the Athabasca River in western Canada. Not only flood hazard, expressed in this case as the probability of flood depths and extents being exceeded, but also flood risk, in which annual expected damages are calculated. Flood risk is calculated, which allows a cost-benefit analysis to be made, so that decisions on the best mitigation options are not based solely on flood hazard but also on the costs related to flood damages and the benefits of mitigation. The river ice model is used to simulate extreme ice-jam flood events with which scenarios are run to determine flood exposure and damages in flood-prone areas along the river. We will concentrate on three mitigation options – the placement of a dike, artificial breakage of the ice cover along the river, the installation of an ice-control structure and the construction of a reservoir. However, any mitigation option is not totally failsafe. For example, dikes can still be overtopped and breached and ice jams may still occur in areas of the river where ice covers have been artificially broken up. Hence, for all options, it is recommended that zoning of building developments away from greater flood hazard areas be upheld. Flood mitigation can have a negative effect of giving inhabitants a false sense of security that flooding may not happen again, leading to zoning policies being relaxed. (Text adapted from Lindenschmidt [2022] "Ice Destabilization Study - Phase 2", submitted to the Regional Municipality of Wood Buffalo, Alberta, Canada)

Keywords— ice jam, flood hazard, flood risk river ice modelling, flood risk.

Happiness and Peace in Daily Mindfulness

Ven. Dharma Sen

Abstract—It's indeed challenging to live with mindfulness and peace in the society. As the human population is increasing drastically with their material expectations, science, rapid update technology advancement and hustle and bustle of life have made the people in the world restless, confusing and intolerance. People everywhere look for medical assistance to improve their health and mental happiness but modern medicine only can cure our physical sickness but not our mental sickness to have inner peace within ourselves. There are so much to be learn and understand with suggestions and various methods in Buddhist mediation for mindful living which are very helpful and beneficial to this world. Through this paper I will discuss various methods to practice mindfulness in Buddhist meditation to elaborate upon how Buddhist monks in the 21st century are more creative and intellectual in their personal careers and with their doctrinal propagation. Their true solid knowledge is identified towards achieving goals, offering significant contributions, and overcoming various barriers in mediation practice to gain inner peace and happiness and wisdom.

Keywords—Awareness, thoughtful, mindfulness, tranquility.

CHALLENGING TO LIVE WITH MINDFULNESS:

As the world population is increasing rapidly the people nowadays are moving too fast with the modernization to adjust their living. To maintain the advancement they working hard to earn and caring to have more and more processions to be happy and wealthy. But the moment they come to understand that their lives have become a robotic way of living where the money cannot truly bring inner happiness and peace then the mind start to think and seek for happiness. But once they come to this point they become more and more restless, upset and worried finally become physically weak and mentally ill. Human mind is very tough to control and understand just to explain that the Buddha said to his followers "one is one's own refuge, who else could be the refuge?"²This was uttered by the Buddha the Blessed one. In order to make his disciples understand he admonished to "be a refuge to themselves and never to seek refuge in or help from anybody else."³ In the Buddhist perspective the Man's position is supreme, man can be the master of his own and there is no any force or power that can control his judgment over his destiny. And to control

¹ This article has been written for the Fifth 21st Century Academic Forum conference at UC Berkeley, from 22-24 August 2016. Rev. Dharma Sen has a strong medical nursing background and profound Buddhist analytical knowledge from Assumption University and Mahachulalongkorn University, in Thailand. As an international researcher he has won several impromptu speech championship trophies from many countries and a gold medal in Speech Olympics Thailand 2016. As a Buddhist missionary monk he has fluency in seven languages and comprehensive knowledge of Buddhist meditation and philosophy. As an experienced meditation master and dhamma preacher, he has also published a few articles in the Wat Bangsao Dong journal and university magazines; and serves as the Secretary of the Bangladeshi Students Association in Thailand. He can be reached at: rb.oppabarua@gmail.com

² Dhp.XII4.

³ D II (Colombo,1929), P.629(Mahāparinibbāna-Sutta)

over our own mind the Buddha preached 'Anapanasati Sutta'⁴ Mindfulness of Breathing. He expounded that there are four methods that we should do as a beginner to work on mindfulness.

THE FOUR FOUNDATIONS OF MINDFULNESS

I. Contemplation of the body (Kayanupassana)

The Buddha pointed out that there are four foundations of mindfulness. First of four foundations of mindfulness, meditator must try to be aware of every single phenomenon within the body.

Element/dhātu Experienced as:

1. Earth (pathavi) solidity, hardness-softness, extension
2. Fire (tejo) temperature, heat-cold, maturing
3. Water (āpo) liquidity, fluidity-contraction, cohesion
4. Air (vāyo) motion, mobility, distension

Our body consists of just four great elements and thus these can be observed in meditation practice. The mindfulness of in-&-out breathing established & pursued so as to be of great fruit, of great benefit. When you breathe in, the air hits your nostrils. That is experience of Vayo (air). You feel cool or hot at that time is you experience Tejo (fire). At the hitting place, hardness or softness can be felt. That is Pathavi (earth). The nature of cohesion and contraction is Apo (water). In breathing out process, all are the same except the air hits your nostrils on its out way back. Learn this process and use the knowledge to practice meditation so that you become fully aware of rising and passing away of all existence.

II. Contemplation of feelings (Vedananupassana)

When you keep sitting with great mindfulness, tiredness or hotness might increase in feeling. If so, you need to change your notion mind from in-breath and out-breath to the feeling you have now. There are three kinds of feeling. They are as following:

- 1) Pleasant feeling (Sukkhavedana)
- 2) Unpleasant feeling (Dukkhavedana)
- 3) Equanimous feeling (Upekkhavedana)

When the meditator has one of three feelings, his notion mind must focus on the feeling, but it is only a feeling, not an ego or "I." This mindfulness and wisdom become helpful in developing greater and more profound mindfulness and wisdom, enabling him to discard the erroneous conceptions of things in terms of "I" and "mine." Buddhist meditation admonished meditators to make aware of the difference between the feeling and mine separately and not to mix them up.

⁴ MN 118 PTS: M iii 78, Anapanasati Sutta: Mindfulness of Breathing,translated from the Pali by Thanissaro

Bhikkhu
<http://www.accesstoinsight.org/tipitaka/mn/mn.118.than.html>

III. Contemplation of consciousness (Cittanupassana)

When you focus on in-breath and out-breath, undoubtedly your mind does not stay with them for a long but wandering. At that time, you need to focus on wondering mind that is appearing and make mental note on them with mindfulness and wisdom. Among five sensorial aggregates, (Khandhas)⁵ the consciousness-group have to be focused on. Moegoke Sayadaw pointed out that there are (13) kinds of consciousness, five insider consciousness, six outsider consciousness, and two residence consciousness.

Five outsider consciousness: 1. Eye-consciousness, 2. Ear-consciousness, 3. Nose-consciousness, 4. Tongue-consciousness, 5. Body-consciousness.

Five insider consciousness: 1. Greed consciousness, 2. Hatred consciousness, 3. Delusive consciousness, 4. Disinterested consciousness, 5. Loving kind consciousness, 6. Wise consciousness

Two home consciousness: 1. Out-breath consciousness, 2. In-breath consciousness

The meditator has to prioritize two home consciousness as they are host consciousness. If other outsider consciousness comes by, pay attention on that one and make mental note "Seeing, seeing, seeing or hearing, hearing, hearing" and so forth. Unless a particular guest, stay with home consciousness. The two consciousness of in-breathing and out-breathing is just a mind, not an ego or "I" or mine. No two consciousness occur at the same time but one by one. There are three parts in each consciousness. They are "started moment", "stable moment" and "ended moment" and try to make aware of each part in each consciousness.

IV. The Contemplation of the mental-objects (Dhammanupassana)

The contemplation of the mental-objects (Dhammanupassana) is meditator focus the mind on the natural processes as they really are. It is not watching the movement of the feelings, bodily and mental actions. Objects coming through the six gates of senses must be observed but just the nature of objects, not in the form of objects. In five sensorial aggregations, Sannakkhandha and Kankharakkhandha are the object of the Dhammanupassana. The meditator can develop anyone of the four foundations of mindfulness depending on the situation and disposition, no matter what it is. Let's take one example here. There is the 'Shwedagon Pagoda'⁶ platform at which has four stairways in four different directions. A pilgrim can choose any direction and stair, no matter where it is and he will reach on the platform at the end of the stairway. Therefore, do not concern about where but how either way we can reach to our destination. According to Moegoke Sayadaw said that there are three levels of mindfulness.

⁵ (Khandhas,) Aggregates usually translated into English. Prior to the Buddha, the Pali word khandha had very ordinary meanings: A khandha could be a pile, a bundle, a heap, a mass.

⁶ The Shwedagon Pagoda is the most famous landmark of Yangon. The 99 meter high gold plated stupa on a small hill is visible from much of the city.

They are 1. Mindfulness 2. Development of mindfulness 3. End of development of mindfulness.

1. **Mindfulness:** The mindfulness is becoming aware of the contemplation of body, feeling, consciousness, and mental objects such as "It is hot, cold, hard, soft, unstable, pained, good, bad etc. In meditation stages, it is just beginning, Sammasana nana, knowledge of difference between mind and matter. It is very basic of Vipassana nana. The real stage of Vipassana is by keeping the practice, later the meditator comprehends three characteristics of impermanent, suffering, non-ego. If so, he is in the third stage, comprehension by groups. (Sammasana nana). The meditator who continues his practice attains knowledge of the arising and falling away of mind and matter. (Udayabbaya nana). They are Vipassanana (to see clearly).

2. **Development of mindfulness:** Development of mindfulness is the contemplation of the arising and falling away of body, feeling, consciousness, and mental objects. This level is Vipassana level too.

3. **Wisdom from development of mindfulness:** The end of development of mindfulness means the yogi reaches cessation of the contemplation of the arising and falling away of body, feeling, consciousness, and mental objects. When you practice insight meditation or develop mindfulness, the four noble truths include in the practice. Therefore, practicing insight meditation and trying to understand four noble truths are exactly the same. How it is is you develop insight meditation that all forms of existence are just mind and matter, not "I", mine, ego, and all of them are rising and falling away then. Rising and falling away is the truth of suffering (Dukkhasacca), thus, no longer attachment for mind and matter is you are getting rid of the truth of craving (Samudaya sacca), understanding all forms of existence are suffering is the truth concerning the path (Maggasacca), no longer life is the truth cessation (Nirodha sacca). In the secret text of Buddhist mentioned that "If by leaving a small pleasure one sees a great pleasure, let a wise person leave the small pleasure and look to the great."⁷

Mindful simply means just focusing on our present movements of the thoughts, feelings and bodily sensation to observe and understand the rapid changes clearly without evaluating the right and wrong consequences.

TOGETHER WITH MINDFULNESS AND WISDOM

The way Moegoke Sayadaw⁸ strongly recommended is the mindfulness and wisdom are kept together in meditation practice. That is called Yoganaddha (Harmonious technique). Like the speed of yoke with two oxen making them close together when they pull plough, it is actually fast. If mindfulness and wisdom are work together harmoniously, you will reach your destination faster. Then the Buddha has

⁷ (Dhammapada 290 / Müller & Maguire, 2002.)

⁸ A well-known meditation master in Myanmar under whom I got my long-term meditation retreat for further details <http://www.dhammadaweb.net/mogok.html>

explained in Mahasatipatthana Sutta⁹ that the manner in which Anapanasati¹⁰ has to be cultivated. One breathes in mindfully, breathes out mindfully. From birth to death this function of in-breathing and out-breathing continues without a break, without a stop.

In order to reach nirvana there are three levels in meditation practice.

1. The first level is knowledge of conformity with the truth (Yathabhuta nana) that the meditator has to cultivate meditation so that he became aware of what truth is.

2. The second level is Knowledge of dispassion (Nibbinda nana) that the meditator needs to cultivate so that what comes through the six sense doors is arid and boring for him.

3. Final level is cultivation so that the meditator can see the cessation of all form of existence. As soon as the meditator reaches this level, he attains nirvana¹¹.

After these three levels, the meditator gets rid of all defilements and obtains nirvana that is ultimate goal of all Buddhist. It's common that practicing meditation to become aware first, and then to get arid and bored and finally to see cessation. So, this advice is absolutely trustworthy and practice meditation accordance with this instruction. These three levels can be more concisely mentioned as insight knowledge (Vipassana nana) and the path knowledge (Magga nana). ¹² This is how both Vipassana Nana and Magga nana can be explained:

- 1. Vipassana nana is like dawn
Magga nana is like sun rise
- 2. Vipassana nana is like a street
Magga nana is like a road
- 3. Vipassana nana is like gathering garbage up
Magga nana is like burning it down
- 4. Vipassana nana is like drying the wood off
Magga nana is like burning them down

By practicing meditation, the meditator's concentration will become stronger and stronger and he will have wonderful experience that is obstacle to higher Dhamma (doctrine) experience. As the Buddha pointed out that the "All that we are is the result of what we have thought. It is founded on our thoughts. It is made up of our thoughts. If one speaks or acts with an evil thought, pain follows one, as the wheel follows the foot of the ox that draws the wagon. All that we are is the result of what we have thought. It is founded on our thoughts. It is made up of our thoughts. If one speaks or acts with a pure thought, happiness follows one, like a shadow that never

leaves.¹³ When our mind control us we do what come to our thoughts and

SUMMARY

Therefore, to conclude this presentation on the need to reform Buddhism is a philosophy and practice that is enormously concerned with the nature of mind and its many delusions, misinterpretations and cravings but, happily for us, sees a way out through higher consciousness and mindful practice in our daily life. Buddha had given the priority to the mind as Buddha's teachings leads to a thorough engagement with lived reality. And through such an engagement with one's self, the world and reality that one is able to achieve a profound knowledge, supreme happiness. Calmness, a deep sense of well-being and happiness, is attainable through proper knowledge and practice in everyday life. This this paper discussed various methods to practice mindfulness in Buddhist meditation to elaborate upon how Buddhist monks in the 21st century are more creative and intellectual in their personal careers and with their doctrinal propagation. Their true solid knowledge is identified towards achieving goals, offering significant contributions, and overcoming various barriers in mediation practice to gain inner peace and happiness and wisdom.

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⁹ The Mahāparinibbāna Sutta is Sutta 16 in the Digha Nikaya, a scripture belonging the Sutta Pitaka of Theravada Buddhism. It concerns the end of Gautama Buddha's life.

¹⁰ "Ānāpāna". The Pali Text Society's Pali-English Dictionary. Digital Dictionaries of South Asia, University of Chicago.

¹¹ Nirvana- is most commonly associated with Buddhism, and represents its ultimate state of soteriological release and liberation from rebirths in samsāra. "Nirvana". Random House Webster's Unabridged Dictionary.

¹² Maggana is one of the sixteen stages, that is, knowledge by which defilements are abandoned and are overcome by destruction.

¹³ Sacred Books of the East, Vol. 10: The Dhammapada and Sutta Nipata, Chapter1-2, the twin-verses. by Max Müller and Max Fausböll, [1881], at sacred-texts.com

Uncertainties and Resilience – A Study of Pandemic Impact on the Pastoral-Nomadic Communities in India

Arati S. Kade, Iftikhar Hussain, Somnath Dadas

Abstract— The paper studies resilience and uncertainties among nomadic-pastoral communities in India during large events such as Pandemic and attempts to understand that with changing times and increased uncertainties how nomadic communities historically showed their resilience. A review of the literature was performed concerning nomadism and development relations and conflicts, by focusing on structural violence on nomadic communities from the caste class and patriarchy as a framework along with the role of state. Philosophical views on anti-nomad bias of political theories by Erik Ringmar along with the decolonial approach by Linda Smith and debrahmanization by Braj Ranjan Mani were used to analyze criminalization of nomads. Data collected using in-depth telephonic interviews and news reports published during the covid-19 lockdown in India. Focusing on Historical context of current crises, the paper leads to the discussion on how nomadic communities negotiates with the sedentary society during covid pandemic. Findings of the current paper approves the hypotheses that covid-19 pandemic followed by lockdown deeply impacted pastoral production system building on the continued cycle of marginalization by the state and caste society in India. While traditional knowledge stood the test of time. Be it developmental states or pandemics the nomadic communities have shown their resilience in number of ways such as keeping distance from sedentary society, usage of traditional medicine and relying on traditional leadership.

Keywords—Covid-19, Criminalization, India, Nomadism, Pandemic, Pastoralism, Resilience, Traditional Knowledge.

I. INTRODUCTION

A pandemic is a historic event, pandemics have affected spiritual, cultural, religious, economic and political aspects of societies in history. For example, the Antonine plague pandemic affected ancient Roman traditions, leading to a renewal of spirituality and religiousness, creating the conditions for the spreading of new religions, including Christianity. The Antonine Plague may well have created the conditions for the decline of the Roman Empire and, afterwards, for its fall in the west [1], [2]. In such a scenario when covid pandemic has the worst hit in the most globalized world it is necessary to understand its effects on different societies.

The worst thing which the covid 19 pandemic brought with it for nomads was the mass desensitization of the whole population, particularly the sedentary one. It created a monster

Arati. S. Kade is with the Department of Anthropology, AISSR, University of Amsterdam, 1018 WV, Netherlands (e-mail: a.s.kdae@uva.nl).

Iftikhar Hussain is an independent researcher, Srinagar, 190001, Jammu and Kashmir, India (e-mail: Iftikhar.sy@gmail.com).

for the nomadic communities. As they did not belong to those sedentary villages but earlier had reciprocal relationships with the agrarian society based on numerous benefits such as agriculture tools, meat, livestock, salt, spices, herbal medicines, toys, jewelry, entertainment which the nomads provided. Which has no importance in the current modern setup, further degrading the reciprocal relationship among nomadic and agrarian communities. The nature of interaction between nomads and sedentarised depends on various ecological, socio-economic and micro-regional variables [3]. But with the onslaught of pandemic, the village community created other layers of ‘boundaries’ which of course its own state which heavily relies on the documentation based on the setup created by the agrarian and settled society, where nomadic communities couldn’t figure out. These layers were not only physically inspired but also strictly enforced by those inequalities created by the caste and class. Nomadic communities are reminded of the usual layers of boundaries that they have been seeing for generations when they ‘migrate’ from one place to another for better pasture or other livelihood reasons on common land. Which, ironically, is also taken over by the agrarian society as free to increase the agricultural land area to further their own production system at the cost of Nomadic communities and their production system.

Keeping in mind the historical marginalization of nomads by state and sedentary society this paper studies the impact of the pandemic on nomadic communities whose socio-cultural and economic aspects of life are entirely different but at the same time interconnected to sedentary society and this paper also try to understand why and how the nomadic communities are reduced to vulnerability by the subsequent governments and made them the victim of the pandemic and how they have negotiated with the same. In this paper, by looking at past and the current pandemic stories of nomads we try to explore how nomadic societies use traditional knowledge to cope with the pandemic. We ask this question to both understand the elusiveness of state help and nomadic societies' knowledge production with regard to such a historical event as a pandemic. What are the changes or lessons brought by the pandemic in their society? The study mostly focuses on pastoral nomadic communities of Maharashtra, Jammu and Kashmir and Uttarakhand.

Somnath Dadas is an independent researcher, Maharashtra, 111045, India (e-mail: somnathdadas123@gmail.com).

For looking at the issues of nomadic societies this research uses a decolonial [4] and debrahminical methodological approach [5]. In-depth telephonic interviews of pastoral nomads from western Maharashtra were conducted for primary data and secondary data was collected through news reports and online lectures conducted by various organizations working with nomadic communities of Maharashtra during the time of ongoing pandemic and state-imposed lockdown.

II. HISTORICAL CONTEXT OF THE CRISES

A. Review Stage

Philosophers of the enlightenment period came up with the idea of ‘universal history’ – the history leading to the establishment of the state in which everyone had to move in the direction in which Europe already had moved [6]. So, history was perceived as unilinear, going in a certain order and direction supported by unilinear theories of development showing humanity evolved from primitive to modern assuming that societies like nomadic would be sooner or later annihilated by history. The blueprint for the ideal city-state which Plato presented is sedentary, walled in, inequalitarian and repressive, with citizenship replacing commercial commitments and laws replacing time-honored customs [6]. Colonialism tends to see the world as static, bounded and sedentary; the Indian state adopted the same ideology. Far from treating them as actors of little consequence, states have often targeted nomads, by marginalizing, mistreating, and perhaps most importantly, through forced sedentarization, states have denied nomads their most basic cultural characteristic, their mobility [7]. The historiography has reflected societies’ treatment of these groups: their imputed criminality, marginality, and poverty – their “stigmatization” – has preoccupied scholars to the detriment of understanding their important economic functions [8]. Nomadic societies are not the opposite of the sedentary society, but they can be alternatives. There are historical evidence that middle and late stone age settlements suggest the existence of a mixed economy combining the produce of hunting-gathering with animal husbandry or exchange of products for meat from the early neolithic communities who already had domesticated animals [9, p. 47]. The existence of nomadism in today’s world, in the presence of all modern means of living sedentary life, is evidence that nomadism is the alternative form of imagination of society. Nomadic can also not be understood through a simplistic definition of way of life applicable to several other related ‘Tribal’ communities who are sedentarized or story of dispossession alone. The ‘placelessness’ which dictated much of the history of nomadic societies has hardly been taken into account.

The numerous reports of violence against the nomadic communities [10]–[15] point toward a very long history of the state and sedentary society’s enmity towards the nomadic societies. Agro-pastoral nomads like Abhiras mentioned in the

puranas¹ were feared as robbers and highwaymen [9, p. 53]. Nomadic communities are seen as violent and aggressive even today by those who at times despise the ostracization of marginalized communities. Starting with the criminalization [16] of around 200 nomadic tribes by the British during the colonial period. And later decriminalization which essentially did nothing but subsumed the criminalization into cultural identities. Ex-criminals, Habitual offenders [17] became the mark of identities. One doesn’t need to ponder much to understand how caste society with its state institutions has been interacting with the nomadic communities historically.

From being criminalized to still being kept outside of the welfare state with numerous policies which are essentially against the existence of the nomadic communities. As Kavoori [18] points out that today the relationship between the Indian developmental state and nomadic communities in India is most agnostic. With numerous restrictions on the migratory roots to various legislations and state and bureaucracy, environmentalism forces nomadic pastoral communities to a forever frugal lifestyle constantly rumbling about their existence [19]. Political developments and policies in the post-colonial south Asian countries have had negative impacts on Nomads.

III. NEGOTIATING WITH STATE AND SEDENTARY SOCIETY DURING THE COVID PANDEMIC

Lockdown was announced on 25 March 2020 at 8 pm in the evening by the prime minister of India to curb the spread of Coronavirus (Covid19). It was announced without giving prior notice and time to the public so that they can prepare themselves for lockdown. This led to a huge disaster impacting around 140 million migrant workers [20], around 8700 migrants workers lost their lives during this time, several among them committed suicide [21], with afresh memories of the first wave of coronavirus when the second wave of covid 19 hit India leading to even bigger disaster which include 200 thousand deaths 9, the second lockdown impacting the economy and health rendering the whole of the population helpless particularly the Bhajans² and specifically the Nomadic communities. The migrant workers’ population in India is mostly comprised of the Dalits, Adivasis, Nomadic tribes and other backward castes. The suffering of nomadic populations during natural as well as manmade disasters is often overlooked by media, government and even civil society [22].

Nomadic communities in the country are the ones who are without homes, the ones who travel from village to village for shelter and work every day to fill their stomachs and were roaming in the pandemic with no shelter in sight. As mentioned in the Renke Commission report 15% of the population of India

¹ Puranas are sacred religious text of Vedic and other indigenous religions in Indian subcontinent. Which were orally narrated for centuries before being written. Writing started since 2nd century BCE.

² Majority of the population in India coming from oppressed castes in the Indian caste system (hierarchical socio-economic division among communities sanctioned by Vedic religion)

is Nomadic Communities³. In the month of January most of the nomadic shepherds migrated to heavy rain regions such as Konkan and to the region where farmers grow cotton and onion crops, remains of which can be used for fodder after harvesting the crops, and hence they were away from their homes. Some of them migrate for 8 months and some for the whole year.

For Nomads ‘home’, a place where they stay, where they eat, and they sleep and perform their daily activities is the camp which is called ‘Birhad’ or ‘Vada’. It is an open space on the outskirts of the villages or someone’s farm where they provide fertilizer in exchange for grains or money [23]. Pastoral nomads set their camp in the area where there is fodder available for grazing within a distance of 5 to 7 km of that area [23]. So, for Nomads reaching their native village and locking themselves inside their home was not possible within very short notice. As a result, they were trapped in different places during the lockdown. A report published in DownToEarth [24] states that people from nomadic and Denotified communities living on footpaths of metropolitan cities were asked to vacate those places and find places where they can confine themselves in close boundaries. People had to struggle to search for such places with short notice. ‘Stay home stay safe’ was the tagline used for convincing people to follow the lockdown, the idea itself is exclusionary for Nomads.

“In Karjat, a case of police brutality towards a person from the Dhangar community has come to light. We understand that the police are taking action on people who are roaming outside, but they must be sensitive while dealing with people who do not have homes. In fact, they must aid them, especially families belonging to nomadic communities, in accessing essential services and facilities in such a time of crisis” said Anand Kokare, Nomadic Shepherd from Maharashtra.

In the month of March when the government announced lockdown, the news did not reach Nomads on time. They were not even aware of the spread of covid 19, they were following their yearly route of migration during that time. They realized about the lockdown when villagers started refusing them entry into the villages, when roads were blocked in several places, and they were not allowed to even wait near some villages. Mentioning the precarious condition of Nomads in the lockdown Professor Narayan Bhosale [25] writes “*People from nomadic communities did not understand the precise meaning of this lockdown during the period of a pandemic. If they did, it was already late; if it wasn't too late, then they were frustrated due to the helpless state it put them in. Nomadic communities have been stranded on the streets in various states, near petrol pumps, playgrounds, and public spaces after the announcement and implementation of the ongoing lockdown.”*

Many villages formed Dakshata samiti in response to Covid 19 to follow the government instructions about lockdown, these committees did not allow anyone from outside to enter the

village. They had to struggle for getting essentials of life, which on normal days they buy from nearby villages. Usually, people from the Nomadic communities used to charge their mobile phone with the help of a friend or a relative from the village, which was not possible during lockdown, so they could not charge their phone and hence were not able to contact people in an emergency.

“Nomadic people were not allowed to come near during the lockdown. In some villages, the sarpanch had published a notice specifying that Dombari, Mendhpal, Davri, Gosavi etc communities are prohibited from entering the village. In Nengre village, a Mendhpal was turned away from a flour mill. Medical stores too would drive us away.”, said Navnath Garale from the Dhangar(shepherd) community, Maharashtra.

The Maharashtra government announced relief packages for the people with ration cards, many among nomadic communities don’t have any documents or ration cards [26]. Even if few nomadic families have ration cards with them, they do not use them often because it is useful only when they stay in their native village, which is rare in the case of Nomads. They are only allowed to avail the benefits of their ration card in ration shops in their native village. If they are on the move, they cannot use the card at ration shops in any other villages they pass by. During the lockdown, there was no special support from the government for the people without ration cards. The Government of India has provided a list of healthy food to be preferred during covid pandemic which includes milk, olive oil, fish, and chicken but there were no guidelines about how economically marginalized and socially outcasted should access these food items. Unequal access to food and health services results in unequal access to good health for the Nomads.

“During the lockdown, we had to struggle to find essentials, it became difficult to get that from villages. Farmers were not allowing us to set up camp in their fields and if someone did the whole village would pressurize him to ask us to leave or he would be the reason for spreading disease in the village. “said Anand Kokare, a nomadic shepherd from Maharashtra.

During the 1st as well as 2nd wave of the pandemic nomadic communities had to struggle for accessing water. Villagers saw them as carriers of coronavirus as they migrate from place to place and hence refused them water from public water resources. Newsclik report [27] stated how nomads from Rajasthan had to arrange cash for purchasing water for daily needs. When the government was informing the need of washing hands every now and then and asking its citizens to wash hands for maintaining hygiene during the pandemic it automatically excluded nomadic communities who were struggling even for drinking water access. Women from the community bear the responsibility of bringing water for the family members and for the load carrier livestock such as horses, during lockdown they were having limited access to

³ There are no attempts from the government to find out the accurate population of the Nomadic communities.

water. It is always women who look after the hygiene of every member of the family and so the lockdown puts an additional workload on their shoulders.

"The villagers would not let us fill the water from the well or would not let us stay in the village. We had to fight for water and fuel in the new place every day.", said Anand Kokare, a nomadic shepherd from Maharashtra.

People belonging to nomadic communities come in large numbers to peripheries of cities like Pune and Mumbai, or to the nearby villages, where there was a large number of cases of people affected by the Coronavirus. They live in open spaces in such places and hence, there was a high possibility of them contracting the disease. In such a situation, there was a need for provisions for their shelter immediately. A report from DownToEarth [24] states that "Both anemia and malnutrition are prevalent among the Scheduled Caste (SC) and Tribe and DNT category, which has direct linkages with their immunity. But for nomads, there was no access to primary health care centers as the borders of the village were sealed. Pregnant women, children, and old age people suffered without medical treatment. There were no facilities for ambulances for pregnant women and they had to deliver children at the camp, which may lead to the death of a child or mother. They could not access medical stores to get sanitizer or masks for protecting themselves from the spread of infections. Moreover, they had no means to access authentic information. Information was not available to them in their language.

The Indian government made it mandatory for the population between the age of 18 to 45 to register online for the vaccination. The nomadic population is educationally backwards and has less access to technology, this compulsion of using digital technology for vaccination drive excluded them from the same. Also, for getting vaccination identity proof were asked by the vaccination centers, Renke commission report states that 50% of the population do not have any identity proof document. In Saswad, Pune, a couple from Nath Panthi Davari Gosavi community was denied a covid test even when they were having symptoms because they failed to provide identity documents. They also did not get vaccination due to the same reason. Mendhpal Putra Army, an organization working on the issues of shepherds of Maharashtra requested then Chief Minister Uddhav Thakarey to allow people from nomadic communities to get free vaccination from any centre accessible to them during the period of their migration without putting any condition of address proof or any other documents. They have also requested that they should be provided with the certificate for vaccination from Sarpanch, Medical Officer of the local representative.

Pastoral nomads in Jammu and Kashmir and Uttarakhand were hacked, looted and beaten for simply travelling with their livestock, at many times state machinery took the opportunity of the Pandemic and subsequent lockdown to harass the Gujjar and Bakker community of Jammu and Kashmir and

Uttarakhand. Specifically, the Pastoral Gujjar and Bakerwal communities who are already facing an existential crisis for their survival from the repercussions of the 2019 lockdown when article 370⁴ was abrogated by the Indian state. It restricted the movement from there on. The pandemic and lockdown have further exacerbated the unwanted changes mostly unhealthy for the Nomadic-pastoral communities of Jammu and Kashmir. The State in Jammu and Kashmir after the abrogation of article 370 and its lockdown took full opportunity to harass the nomadic communities. Numerous events of demolishing temporary huts and police brutality were reported [11], [28]-[34]. After many hues and cries the State implemented the Forest rights act (FRA) 2006 in 2020 in Jammu and Kashmir. However, the process of implementing such a law is under a lot of suspicions. Because on a daily basis there are reports that nomads are still being harassed by the police and the department of the forest.

IV. NOMADIC PASTORAL PRODUCTION SYSTEM IN THE PANDEMIC

The economy of pastoral nomads is dependent on the sale and purchase of the sheep and goats to the local meat sellers and other produce in the market. They sell their sheep and goats when they reach the age of at least three to four months or when in need of money. Out of that money earned they invest money in the form of medicines for sheep and other livestock [23]. Pastoral products like wool, leather, ghee and meat were having commercial value and pastoralists were historically major factors in the regional economy [9, p. 55]. These nomads must wander in order to feed the livestock that is their livelihood. The lockdown brought their wandering (seasonal migration) to a standstill and once the feed available at whichever place they were stuck in had run out, the livestock faced the real possibility of death due to starvation and diseases. Such a stoppage to the movement of the nomadic communities is a bane for the pastoral economy altogether in several ways. Particularly the pastoral one for example the pastoral Buffalo of the Banni Pastoral community of Gujarat in Kutch region travels about 15kms to graze in the Banni grasslands. Similarly the Gojri Buffflow which is an indigenous animal to the Muslim gujjar pastoral community in Jammu and Kashmir, Himachal and Uttrakhand travels long distances to graze. The peculiar thing about the pastoral animal is that they are genetically bred to travel long distances and travel long distances to graze. They are not bred to stall-feed. If they are stall-fed and they did not move much or travel to graze the quality of the livestock will reduce. Which the pandemic and govt. Policies had induced. The Gene-bank as Pastorals are called must have to have free access to grazing lands and commons without any hindrance to continuously keep moving the pastoral economy as will the culture which is strongly aligned with one specific feature of movement and that be free movement. The government

⁴ Article 370 was the law in Indian constitution which protected the sovereignty and on which the future relationships among two states was based.

machinery took no steps and implemented no measures to tackle the issues of fodder shortage. These animals are their only source of livelihood, so it is very important that they be provided with fodder wherever they are.

The nomadic communities who solely rely on seasonal income such as through selling of livestock, iron tools or herbal medicines suffered huge losses. On the one hand, restrictions on the movement made it impossible to move to another place and on the other, the villagers' antagonism towards the 'outsiders' completely cut off the nomadic communities from its economy. The first lockdown without any warning and planning by the state brought havoc on the production system of the Nomadic communities.

In the summer Bakarwal nomadic communities in the Jammu and Kashmir region begin movement towards hilly and mountainous regions. From the onset of the month of May, the nomadic-pastoral communities from Deccan region migrate to other places for better pastures; the lockdown which coincided with the seasonal migration put a break on the migration. The COVID-19 pandemic and the associated lockdown for a long period have created a significant adverse impact [35] on the lives of Pastoral communities. As pastoral livestock must move from one place to another to remain healthy. Nomadic livestock cannot be staff feed, as it is bred for a specific reason so that it can travel long distances. With no movement the livestock gets into closer contact and falls prey to diseases.

The sale of sheep also stopped because of the smear campaign and vilification of Tablighi Jamaat . Since they mostly supply animals to Muslim butchers and people had started boycotting Muslim traders. On the other hand, Muslim gujar communities from Jammu and Kashmir even when they are not associated with Tablighi Jammat have became target due to the hate being spread on social media [14]. A few of these shepherds also do farming after the months of April and May, after selling their livestock and earning capital to invest in agriculture. This chain of earning livelihood came to a breakdown due to the lockdown. As lockdown stopped the any type of migration be it seasonal migration of Muslim Gujjar Pastors or constant migration on which most of the Dhangar pastoral Shepherds of Maharashtra rely.

At the time of sowing, fields are not empty, and farmers don't let them sit anywhere near the field. So pastoral nomads migrate to their native villages or to an area with less rainfall. This migration process should ideally begin by May to mid-June and if it is delayed, there is a chance that the livestock will catch diseases and the nomads will suffer grave losses. The lockdown made the situation more difficult. The process of returning to the native village that begins in May stopped in its tracks even before it could begin. They have stuck in unknown villages far away from home, everyone had begun looking at each other with suspicion. The people who were stuck in Konkan were in a particularly difficult situation. It is imperative for them especially to begin the return journey in May itself because the Mrig Nakshatra rain in Konkan is considered to be lethal for their sheep since their mortality goes up considerably during this period. But police did not let them pass through the Khandala Ghat (path through mountains). Rearing young lambs

or sheep became difficult for shepherds during lockdown because young lambs need to feed a special diet to increase quality and weight. Heavy rain is not good for animals' health and protecting them in the monsoon was also difficult because once a sheep gets wet in the rain, it affects their weight and quality. In Malshej Ghat, shepherds could not harvest their sheep's wool. Usually, it is done by specially skilled Dhangars but since the lockdown has brought all means of contact and travel to a standstill, it was impossible to do it.

The animals used for meat are supposed to be sold in the market within a specific timeframe. If they fail to sell animals within a time frame, it results in huge economic losses. Also, some of the shepherds had a huge loss of income due to the unavailability of the transportation system and market. The sale of meat is highly dependent on local and informal markets. Markets in the rural areas were entirely closed due to the lockdown. The summer season is one of the biggest seasons of festivals (Jatra) of sacrificing sheep or lamb to God. So this is the biggest period for animal selling as local people also buy animals to offer sacrifice. But the government declared that all festivals had been cancelled in a period of lockdown resulting in economic loss.

"With the livestock market closed, the economic math collapsed. The three-month-old lamb was supposed to be sold, but now it is eight or nine months old. Once they get older, their value doesn't last, so now they seem to be wasted. However, they require continued feeding. I sold the lamb to the merchants. Even though the price of mutton is not low, traders give us lower prices by saying its lockdown and they are facing loss", said Anand Kokare.

In Indian caste society Brahminical forces always lead the campaign against culture of meat eating castes. Brahminism tries to put various restrictions on meat eaters. They took the opportunity of the pandemic to accelerate their campaign. Hindu Mahasabha made a claim that 'Corona is not a virus, but avatar for the protection of poor creatures. They have come to give the message of death and punishment to the one who eats them' [36]. The same campaign was conducted on the Twitter with hashtag #NoMeatNoCoronavirus. This campaign saw the closure of most meat shops in the country [36] affecting the sale of goats and sheep.

"In March, some of the people avoided eating non-veg due to rumours. Even local traders do not buy sheep due to a lack of demand from customers. So basically, the value chain was disrupted. The chain of earning livelihood came to a breakdown due to the lockdown.", M Khatal, Dhawalpuri Ahmednagar.

Later it is found that in order to improve immunity it is beneficial to eat meat. So at a few places, shepherds sold mutton without the help of a butcher, mainly at the village level. This proved beneficial for shepherds and also, they could understand the true cost of their product in the market.

In many places, traders bought the lamb for free or at low prices, citing lockdown. The shepherds themselves cut the lamb

but do not get a good price for the mutton because some customers purposefully avoided paying them because they will be leaving the village soon and cannot come back for money.”, said Navnath Garale, a nomadic shepherd from Maharashtra.

In the summer, it is necessary to administer sheep with the etv vaccine which prevents diseases. But due to the lockdown, the Animal Husbandry Department did not carry out a vaccination drive. Pastoralists claimed that government veterinary doctors did not provide medicine on time in the period of lockdown. They are given reasons for the unavailability of vaccination due to lockdown, pastoralists think that they were trying to avoid coming out of home for their safety. Also, the government does not include veterinary doctors in COVID Insurance or does not provide them with any facilities or protection so that they can work during pandemics.

“The sheep were slaughtered because the medicine was not received on time. Animal vaccines were not available at government hospitals.” said Navnath Garale

“The animals were not vaccinated last year, and the early rains increased the incidence of the disease”, said Anand Kokare

Also, the dairy sector sustains thousands of small and poor milk farmers, traditional cattle keepers and pastoralists. Many of them have for long been struggling in the shadow of agrarian distress in the drought-affected region of Maharashtra. They will face an even more uncertain future now. The big dairies too, including Mother Dairy, a subsidiary of the National Dairy Development Board, stopped procuring milk during the lockdown. Pastoralists faced surplus problems during the lockdown, and most private customers have procured milk in less quantity due to dwindling income. Pastoralists estimated that the financial loss will probably persist for a long time, running into thousands of rupees of daily income, for everyone involved in the sector’s long supply chain.

Pandemic will not only reduce the quantity of the indigenous livestock but at the same time, the quality of the livestock will reduce. Along with the indigenous livestock, the indigenous knowledge system of super specialized breeding will be extinct. The pastoral nomadic communities will be rendered to a frugal lifestyle similar to the non-pastoral nomadic communities. Covid pandemic thus will have a long-lasting impact on non-industrial food pastoral economy and if pastoral nomads do not receive the needed support, it is clear to them that the most vulnerable will risk losing their livestock and settling in villages and cities and working as unskilled labourers. The pandemic along with the government policies will exacerbate the sedentarization of Nomadic communities.

V. TRADITIONAL KNOWLEDGE AND RESILIENCE

In ancient Greek society during epidemics such as the plague epidemic, Nomads were acknowledged in their capacities as wandering healers with cures or healing music [37]. Ruth Meserve believes that nomadic use of the pastures in Central

Eurasia is closely related to traditional shamanic folk medicines. He mentions, “*It relates to geographic space and to the distribution of natural resources and disease areas. Mental maps show that infection paths are localized and boundaries and spatial markers are put up against the spread of disease, combining empiric and cosmologically defined spaces. Also, nomadic etiology in many cases infers disease from ‘dead land’ (körös ügei): pasture that has ‘lost its skin’ through building, farming, etc.*” Traditional ecological knowledge enables pastoralists to cope with social-ecological changes, thereby increasing the sustainability of their practices and fostering social-ecological resilience[38]. During the Justinian plague pandemic in mid 6th century AD, the nomadic Arab tribes, moving through sparsely populated areas, practised a form of protective isolation [39]. Innu- nomadic hunter community of Labrador populations tended to be dispersed in small camps in the interior of Labrador during all seasons except the summer and this may be responsible for their apparent escape from the ravages of the 1918-19 Influenza pandemic [40].

In many parts of South Asia in times of ecological crisis such as prolonged drought or pandemic pastoral nomadic communities resort to adaptive strategies that were practised in these areas some 2000 years ago [9, p. 45]. While discussing how Indian masses dealt with the 1897 plague pandemic, Kancha Ilaiah [41] wrote about strategies applied by shepherds and cattle herders from Telangana. He mentions that shepherds, fishers and cattle herders migrated to distant areas with their livestock and fish economy. During that time Hyderabad Nizam State had a lot of forests and semi-forest land available for grazing animals and fishing resources along the rivers and streams.

“My grandparents along with hundreds of shepherd families were said to have migrated in that pandemic plague from Ursu, Karimabad what broadly known as Fort Warangal town (these towns were set up during the Kakatiya rule from 13th century onwards) to Pakala patte. The Pakal lake which was built during the Kakatiya regime near Narsampet was a major water source to several settlers around the lake and the streams that it engendered. Mainly Shepherds called Kuruma Gollas, Fishers called Mutirajas and cattle herders called Lambadas migrated to forest and semi-forest zones between Bahabubabad and Narsampet.” he writes.

According to the nomadic pastoralists community of Iran nomadic way of life protected them from the covid 19 virus because they are relatively isolated [42]. During covid 19 pandemic Bakarwals [2] from Jammu and Kashmir united to pressurize the government to allow them mobility during lockdown because it was important for them to reach hilly regions to save their livestock from heat and scarcity of fodder. They manage to get permission from the state. For them reaching pastures from the hilly region was also going away from the covid crisis that created havoc in the settled population of urban as well as rural areas. In Maharashtra when the camps of Dhangars were stuck in the Konkan region as police and administration were not allowing them to start the movement, shepherds dispersed all over Konkan contacted each other

formed their list and requested the government to allow them to move upward. Presence of traditional leadership, group cohesion and geographic seclusion proved beneficial for them while dealing with covid 19 crisis [2].

Diseases like cold and fever are common among pastoral nomads because each time they change place the quality of water changes. In such cases, these nomads prefer to use traditional medicines instead of going to the doctor. In the case of corona for mild symptoms, nomads avoided going to the doctor and used traditional methods for improving immunity like goat milk which is highly medicinal according to nomads because these goats eat 12 different plants; they also preferred mutton, eggs, turmeric and ghee. They also preferred to do medical treatment of their livestock on their own in the absence of vets. In non-pandemic days too nomads are used to living isolated and independent social and cultural life from the sedentary society which helped them during pandemics.

Mendhpal Putra army- an organization of nomadic shepherds from Maharashtra conducted the campaign for helping shepherds to register online for covid 19 vaccination but very few showed up for the same. These nomads were conservative about vaccination drives and want to protect themselves from infection by using other measures like improving immunity and staying away from sedentary society instead. The phenomenon of social distancing was not new to nomads, especially pastoral nomads because they always prefer to set up their camps in forest or semi-forest regions at a distance from sedentary society. In the case of the Bakarwal community of Jammu and Kashmir or Dhangar community of Maharashtra the specific nature of their living adjacent to their livestock and in seclusion from local settlers served as a zone of confinement, where the chances of getting infected were reduced (Majeed, 2020). Jamal Hussain, a nomadic pastoralist from Jammu and Kashmir said, "*This is the disease of these people; this will be here in these cities. We don't have any fear of it; we are being unnecessarily restricted.*" [2]. These communities believe that their pastures are serene, bountiful, and protected by nature such diseases like covid19 come from industrial or agricultural land.

We must note here that pastorals can fallback on grazing lands, and commons for resilience, but for nomads who aren't depending on livestock this kind of resilience is not possible. For nomadic communities who are referred to as service nomads by Joseph C Berland, nomads who practice nomadism of different forms where to have to keep in constant touch with sedentary society. For them people from sedentary societies are their customers; they are as important to them as pasture lands to pastoral nomads [3, p. 107]. Due to their peculiar position they have to be in a social and economic relationship with the sedentary society where they are constantly policed, marginalized and ostracized as outsiders and rejects of the society. Forever forcing nomadic communities particularly non-pastoral communities to have a frugal living. And that frugal living is in built in the state and society, particularly a caste society. The following example mentioned by Kerr, I. J. [8] shows how disruption in the livelihood of one of the nomadic communities in India led to the degradation of socio-economic and cultural aspects of the community.

"Banjaras were present in India from early times. They flourished in the Sultanate and Mughal period – from the north-west deep into the Deccan – because, in those centuries of widespread military campaigning, they came to transport crucial supplies to armies in the field. widespread British control over India in the early decades of the nineteenth century marked the beginning of the end of six centuries of Banjara success as transporters. The colonial authorities, in fact, wanted a sedentary, peasant India. The next 150 years saw the Banjaras struggle to survive and adapt. Railways, the great technology handmaiden of industrial capitalism and the instrument of a strengthened colonial state, opened in India from 1853 onwards and reached a tentacular 23,627 route miles in 1900, largely ended the Banjaras' role as long distance, bulk commodity transporters. Ironically, in western India, Banjaras (regionally Vanjaris) in and around Bombay came to have a major presence among those who worked as railway station porters."Kerr, I. J. [8]

VI. CONCLUSION

Nomadism of any form requires a certain type of 'migration' i.e., moving from one place to another. The state measures like lockdown to control covid 19 pandemic impacted directly the basic characteristics of nomadism; for nomads compromising mobility led to the compromising of culture, politics and economy. Stigmatization by society as carriers of virus resulted in their suffering without basic needs and stigmatization of meat eaters by Brahminical forces holding them responsible for pandemic impacts on their economy as meat sellers. Ranging from the formation of nation-states and borders to the formation of every new policy of those states related to land, environment or mobility has negatively impacted pastoral nomads and even the impacts of these changes are measured from the normativity of sedentary society. Amidst all these direct indirect attacks from state and sedentary society pastoral nomads survived pandemic with the help of their cultural characteristics like sovereignty, economic self-sufficiency, environmental harmony, versatility, flexibility and nomadism because sustainability itself is a goal in nomadism. Mobility helps them in seizing opportunities for sustaining and surviving. For pastoral nomads viruses are yield of industrial and agricultural land which is a land which has lost its skin or a dead land. Traditional knowledge and faith over nature helps them to deal with such disasters.

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Cognitive and Functional Analysis of Experiencer Subject and Experiencer Object Psychological Predicate Constructions in French

Carine Kawakami

Abstract—In French, as well as in English, there are two types of psychological predicate constructions depending on where the experiencer argument is realized; the first type is in the subject position (e.g. Je regrette d'être venu ici. 'I regret coming here'), hereinafter called ES construction, and the second type is in the object position (e.g. Cette nouvelle m'a surpris. 'This new surprised me.'), referred as EO construction. In the previous studies about psychological predicates, the syntactic position of the experiencer argument has been just a matter of its connection with the syntactic or semantic structure of the predicate. So that few attentions have been paid to how two types of realization of experiencer are related to the conceptualization of psychological event and to the function of the sentence describing the psychological event, in the sense of speech act theory. In this research, focusing on the French phenomena limited to the first personal pronoun and the present tense, the ES constructions and the EO constructions will be analyzed from cognitive and functional approach. It will be revealed that, due to the possibility to be used in soliloquy and the high co-occurrence with *ça* ('it'), the EO constructions may have expressive function to betray what speaker feels in *hic et nunc*, like interjection. And in the expressive case, the experiencer is construed as a locus where a feeling appears spontaneously and is construed subjectively (e.g. Ah, ça m'énerve! 'Oh, it irritates me!'). On the other hand, the ES constructions describe speaker's mental state in an assertive manner rather than the expressive and spontaneously way. In other words, they describe what speaker feels to the interlocutor (e.g. Je suis énervé. 'I am irritated.'). As a consequence, when the experiencer argument is realized in the subject position, it is construed objectively and have a participant feature in the sense of cognitive grammar. Finally, it will be concluded that the choice of construction type, at least in French, is correlated to the conceptualization of the psychological event and the discourse feature of its expression.

Keywords—French psychological predicate, conceptualization, expressive function, assertive function, experiencer realization

Carine Kawakami is with the Tokyo University of Foreign Studies, Tokyo, Japan (e-mail: carinek963@yahoo.co.jp, carine963@tufts.ac.jp).

Compliance and Assessment Process of Information Technology in Accounting, in Turkey

Kocakaya Eda, Argun Doğan

Department of Accounting and Finance, Marmara University, Istanbul/Turkey

Abstract

This study analyzed the present state of information technology in the field of accounting by bibliometric analysis of scientific studies on the impact on the transformation of e-billing and tax management in Turkey. With comparative bibliometric analysis, the innovation and positive effects of the process that changed with e-transformation in the field of accounting with e-transformation in businesses, and the information technologies used in accounting and tax management were analyzed comparatively. By evaluating the data obtained as a result of these analyzes, suggestions on the use of information technologies in accounting and tax management and the positive and negative effects of e-transformation on the analyzed activities of the enterprises were emphasized. With the e-transformation, which will be realized with the most efficient use of information technologies in Turkey. The synergy and efficiency of IT technology developments in accounting and finance should be revealed in the light of scientific data, from the smallest business to the largest economic enterprises.

Keywords: Information Technologies, E-invoice, E-Tax Management, E-transformation, accounting programs

Advertising Incentives of National Brands against Private Labels

Lu Liao

Abstract— This paper studies the impact of private labels on the advertising incentives of national brands. The worldwide expansion of private labels over the past two decades not only transformed the choice sets of consumers but also forced manufacturers of national brands to design new marketing strategies to maintain their market positions. This paper first develops a consumer demand model that incorporates spillover effects of advertising for antacids, including private labels and finds positive spillovers of national brands' advertising on demand for private label antacids. With the demand estimates, it provides a simulation for the equilibrium prices and advertising levels for leading national brands in a counterfactual where private labels are eliminated to quantify national brands' advertising incentives as a response to the rise of private labels.

Keywords— advertising, private label, marketing, demand.

Lu Liao is with the in Shandong University, China (e-mail: lliao5@wisc.edu).

Chatbots in Education: Case of Development Using a Chatbot Development Platform

Dulani Jayasuriya

Abstract— This study outlines the developmental steps of a chatbot for administrative purposes of a large undergraduate course. The chatbot is able to handle student queries about administrative details, including assessment deadlines, course documentation, how to navigate the course, group formation, etc. The development window screenshots are that of a free account on the Snatchbot platform such that this can be adopted by the wider public. While only one connection to an answer based on possible keywords is shown here, one needs to develop multiple connections leading to different answers based on different keywords for the actual chatbot to function. The overall flow of the chatbot showing connections between different interactions is depicted at the end.

Keywords— chatbots, education, technology, snatch bot, artificial intelligence.

Dulani Jayasuriya is with the in University of Auckland, New Zealand (e-mail: d.jayasuriya@auckland.ac.nz).

Bellum Letale: Evidence from Nagorno-Karabakh War

Arevik Sargsyan

Abstract— Destruction, trauma, and resilience are the main by-products of wars that lead to drastic changes in the mosaics of the affected societies. Whether violent conflicts can foster greater ex post stakeholder involvement in the socio-political life of a state is an important parameter of scrutiny for an effective design of a recovery model. The analysis of the war-induced alterations to prosocial behavior, in turn, constitutes an insightful channel for integrating the role of normative perspectives in the contextually congruent formation of long-run state strategies. The aim of this replication paper is to study the links between war victimization, civic engagement, and egalitarian choices based on two distinct exercises adopted from prior research and adapted in accordance with the existing theory. For the purpose of analyzing the effect of war victimization on civic engagement a survey was conducted, the results of which revealed a positive relationship between individual victimization and participation in several forms of civic engagement, convergent with the findings of the previous research. The second block of the analysis, which was based on an experiment, in turn, identified an enhancement of in-group manifestation of egalitarian motives by individuals with higher victimization scores, implying a stronger preference towards equal choices. In a post-war reality characterized by weak institutions, eroded trust, and risky transitions, these results signal on the prevalence of vibrant domestic social capacity that can be mobilized in favor of reinforcing ex post the debilitated principles of democracy and protecting the national interests of the state. Considering the important role that expectations of the future can play in economic policymaking and outcomes, the findings altogether convey crucial implications for post-war rehabilitation, societal revivification, and economic recovery by providing fertile grounds for reestablishing societal trust and building a post-war national narrative that would emphasize the demonstrated capacity of the society to bear the burden of the war trauma, rebooting civic and collective efficiency.

Keywords— behavioral economics, psychology, egalitarian motives, civic engagement, victimization.

Arevik Sargsyan is with the in Université Paris 1 Panthéon-Sorbonne, France (e-mail: arevsargsian@gmail.com).

The Carbon Tax and The Emissions Trading System (ETS): An Analysis of The Performance of the Two Mechanisms

Assaad Ghazouani

Assaad Ghazouani is with the in University of Tunis El Manar, Tunisia (e-mail: ghazouani_assaad@yahoo.fr).

Abstract

The carbon tax serves as a price instrument that encourages a transition to cleaner production by imposing additional costs on emitters in proportion to their emissions (Carattini et al., 2019; Haites, 2018). Carbon tax is levied on fossil fuels and related products such as coal and gas based on their carbon content to reduce fossil fuel consumption and carbon emissions. The ETS is a market-based measure with greater flexibility, as the price of carbon can fluctuate with the supply and demand for carbon emission allowances (CEAs) (Deng et al., 2018; Qian et al. al., 2018). In addition, the ETS having the merit of strictly limiting projected emissions below a given level, it is now widely adopted by the European Union, Switzerland, Australia, New Zealand, Korea from the south, etc. (Caciagli, 2018), way to achieve temperature goals of 1.5 C or 2 C (Fang et al., 2021; Tang et al., 2015). In order to provide evidence for the countries which must introduce the tax, we estimate the real mitigation effects of the carbon tax on the countries of the European Union of the 25 and the 28 i.e. before and after the entry into force. entry into force of the Kyoto Protocol.

1. Introduction

Climate change is now an indisputable fact and its damage to human beings has become one of the most serious threats in the world. Their main origins are GHGs, mainly CO₂ whose origin and consumption of fossil fuels.

In order to reduce CO₂ emissions, many methods have been implemented, including energy tax, carbon tax, emission standards and emission trading systems.

the carbon tax serves as a price instrument that encourages a transition to cleaner production by imposing additional costs on emitters in proportion to their emissions (Carattini et al., 2019; Haites, 2018). Carbon tax is levied on fossil fuels and related products such as coal and gas based on their carbon content to reduce fossil fuel consumption and carbon emissions.

The ETS is a market-based measure with greater flexibility, as the price of carbon can fluctuate with the supply and demand for carbon emission allowances [1] [2]. In addition, the ETS having the merit of strictly limiting projected emissions below a given level, it is now widely adopted by the European Union, Switzerland, Australia, New Zealand, Korea from the south, etc. [3], way to achieve temperature goals of 1.5 C or 2 C [4] [5].

Many existing empirical studies expose the theoretical mechanisms and realities of the effect of the ETS and the carbon tax on carbon emissions. The results of [6] indicate that the carbon tax in Finland has a significant and negative impact on the growth of CO₂ emissions per capita. At the same time, the effects of the carbon tax in Denmark, Sweden and the -Bas are negative but not significant. The mitigation effects of the carbon tax are weakened by the tax exemption policies of certain energy-intensive industries in these countries.

According to [7] the implementation of a tax of \$100/tonne.C can only reduce the rate of growth of emissions. [8] suggest that the combined action of energy efficiency and industrial structure has a potential positive influence on the synergistic effect of reducing ETS emissions. Considering the complex mechanism of ETS, industrial structure, energy consumption structure, and economic development are all defined as conduction pathways. According to [9], the ETS is an effective instrument to stimulate structural adjustment in highly polluting industries and eliminate lagging production capacities.

The results of [10] [11] [12] [13] on the effects of the ETS in reducing CO₂ emissions are significant in the short term and this will be reinforced in the long term. . In case the effects of ETS are not significant in terms of emission reductions, [14] used ETS data in European countries to discuss the real effect. Their results showed that the EU ETS has yet to reach its true potential to reduce emissions in a cost-effective way.

In order to provide evidence for the countries which must introduce the tax, we estimate the real mitigation effects of the carbon tax on the countries of the European Union of the 25 and the 28 i.e. before and after the entry into force. entry into force of the Kyoto Protocol.

This article is organized as follows: Section 1 is the introduction, the main existing studies on the effects of the carbon tax will be passed to section 2. Section 3 describes the methodology used to estimate the mitigation effect carbon tax and data source. Section 4 will analyze the empirical results, while the main conclusions and recommendations are summarized in Section 5.

3. methodology and data

3.1. Basic model: Kaya's equation

The Kaya equation [16] used in the work of the IPCC takes up the IPAT equality by considering the environmental impact of CO₂ emissions. Moreover, it splits the technology component into two factors, energy intensity (EI) and carbon intensity (CI). Energy intensity is the primary energy consumption (PE) per unit of gross domestic product (GDP), i.e. the inverse of the energy factor productivity. Carbon intensity is the fossil energy content of a unit of primary energy consumption.

Kaya's equation is therefore the following:

$$CO_2 = P \times GDPC \times EI \times CI$$

$$\text{with : } GDPC = \frac{GDP}{P}, EI = \frac{PE}{GDP}, IC = \frac{CO_2}{PE}$$

From this equation, the effects of the different variables and their evolution over time can be studied whatever the geographical scale chosen (city, region, country, World).

Since the 1970s, on a global scale, variations in population and per capita GDP have been described by the IPCC as two powerful factors in the increase in emissions. The positive and long-term link between the product per inhabitant and the ecological impact contradicts the environmental Kuznets curve, which seems verified for certain local pollutants but not for CO₂ emissions [17] [18]. The demographic and wealth effects are partially offset by the drop in energy intensity following the first oil shock, and by that of carbon intensity in the 1980s and 1990s.

The presentation proposed by Y. Kaya clearly poses the challenge: what should be the additional investment effort in the transformation of the energy system, insofar as the progress recorded in energy efficiency and the decarbonization of energy n were not enough to offset the impact of the other variables? The absolute reduction in CO₂ emissions advocated by the IPCC by 2050 to avoid an increase of more than 2° in temperature implies that the last two factors of the equation decrease at a rate greater than that of the increase in the two first.

Work based on Kaya's equation generally breaks down the effects of different factors on CO₂ emissions by period. We can thus assign to each factor the variation in emissions that is responsible for it, then analyze the changes from one period to another [19].

The effect of each of the factors is calculated all other things being equal, the others remaining unchanged. Several decompositions are possible. One can, for example, take the fixed value of the other factors in the year of departure (Laspeyres method with constant weighting) or the year of arrival (Paasche method with variable weighting). But they reveal important residuals, i.e. variations that would not be attached to a particular factor but to the interaction between several of them. The sum of emissions attributed to each factor would then be underestimated or overestimated [20].

3.2. Méthodologie

The model to be estimated is the following based on the work of [21] [22] [16]

$$CO_2 = x'\beta + \alpha t + \epsilon_i \quad (1)$$

Where $x' = \{pop, gdpc, co2ec, ecgdp\}$ is a vector of covariates that affect the outcome. CO₂: Carbon dioxide emissions, gdpc :GDP per capita is the gross domestic product divided by population, ecgdp: energy intensity (IE) $ecgdp = ec/gdp$, co2ec: carbon intensity. $co2ec = co2/ec$. β and α are coefficients to be estimated, and ϵ_i are error terms. t_j is considered a dummy variable taking the value 1 if a country adopts a carbon-tax policy, and 0 if not.

The treatment assignment process is

$$t = \begin{cases} 1 & \text{if } w'\gamma + \tau > 0 \\ 0 & \text{otherwise} \end{cases}$$

where γ is a vector of coefficients, and τ is an unobservable error term that is related neither to x nor w . The process of processing assignment is also separated into a predictable component, $w'\gamma$ and an unobservable error term τ .

This potential result model specifies that the observed result variable y is y_0 when $t = 0$ and y is y_1 when $t = 1$. Algebraically, we say that

$$co_2 = (1 - t)co2_0 + tco2_1 \quad (2)$$

The processing assignment process is:

$$co2_0 = x'\beta_0 + \epsilon_0 \quad (3)$$

$$co2_1 = x'\beta_1 + \epsilon_1 \quad (4)$$

Three metrics are often used to measure treatment effects: mean treatment effect (ATE), mean treatment effect on treatments (ATET), and mean potential outcome (POM). In this section, we use the average treatment effect over treatments (ATET)

ATE is the average effect of treatment in the population:

$$ATE = E(co2_1 - co2_0) \quad (5)$$

ATET: is the average effect of treatment among those receiving treatment:

$$ATET = E(co2_1 - co2_0 | t = 1) \quad (6)$$

- **Atet Neighbor Matching method**

For each treated observation i , select a control observation j that has the closest x .

$$\min \| p_i - p_j \|$$

- **Radius matching**

Each treated observation i is matched with control observations j that fall within a specified radius.

$$\| p_i - p_j \| < r$$

- **Kernel matching**

Each treated observation i is matched with several control observations, with weights inversely proportional to the distance between treated and control observations.

- With matching based on propensity scores, the weights are defined as:

-

$$w(i,j) = \frac{K(\frac{p_j - p_i}{h})}{\sum_{j=1}^{n_0} K(\frac{p_j - p_i}{h})}$$

Here h is the bandwidth parameter.

- **stratification ou interval matching**

Compare the outcomes within intervals/blocks of propensity scores.

3.4. données et sources

- **CO₂** : Carbon dioxide emissions are those that arise during the combustion of fossil fuels and the manufacture of cement. They include carbon dioxide emissions produced during the consumption of solid, liquid and gaseous fuels and from flaring.

- **Pibh** : GDP per capita is gross domestic product divided by mid-year population. GDP is the sum of the gross value added of all resident producers in an economy plus any taxes on products and minus any subsidies not included in the value of products. GDPH = GDP / P

- **IE** : energy intensity (EI): Energy intensity is the primary energy consumption (PE) per unit of gross domestic product (GDP), i.e. the inverse of the energy factor productivity. EU = PE / GDP

- **IC** : carbon intensity (CI). Carbon intensity is the fossil energy content of a unit of primary energy consumption. CI = CO₂ / EP

- **POP**: The term population refers to all the inhabitants living in a country, region, city, or specific place.

- **t** : binary variable 1 if the country has adopted a carbon tax and 0 otherwise

Table 1: List of countries that have adopted the carbon tax

Treated group				control group			
Carbon tax	Year of application	ETS	Year of application	Australie	Israël	Autriche	Costa Rica
Danemark	1992	Allemagne	2005				
Finlande	1990	Royaume-Uni	2005	Canada	Japon	Belgique	Estonie
Lettonie	2004	Italie	2005	Chili	Mexique	Portugal	Grèce
Norvège	1991	France	2005	Corée	Nouvelle-Zélande	Pays-Bas	Hongrie
Slovénie	1996	Pologne	2005	États-Unis	Suisse	Irlande	Lituanie
Suède	1991	Espagne	2005	Islande	Turquie	Colombie	Luxembourg

5. Result and analysis

5.1.Result

5.1.1. The common support

Table 2 : Commun support

Combined	0.32328009	0.72935366
Tax	0.48663187	0 .70017124
Ets	0.2727751	0.46011684

The common support is the zone of overlap of the two groups on all the values of the propensity score [23]. The common support of the propensity score makes it possible to ensure that it is possible, for each individual of the treated group, to find at least one participant of the control group having the same initial characteristics (propensity score). The use of the propensity score is appropriate only for individuals located in this zone.

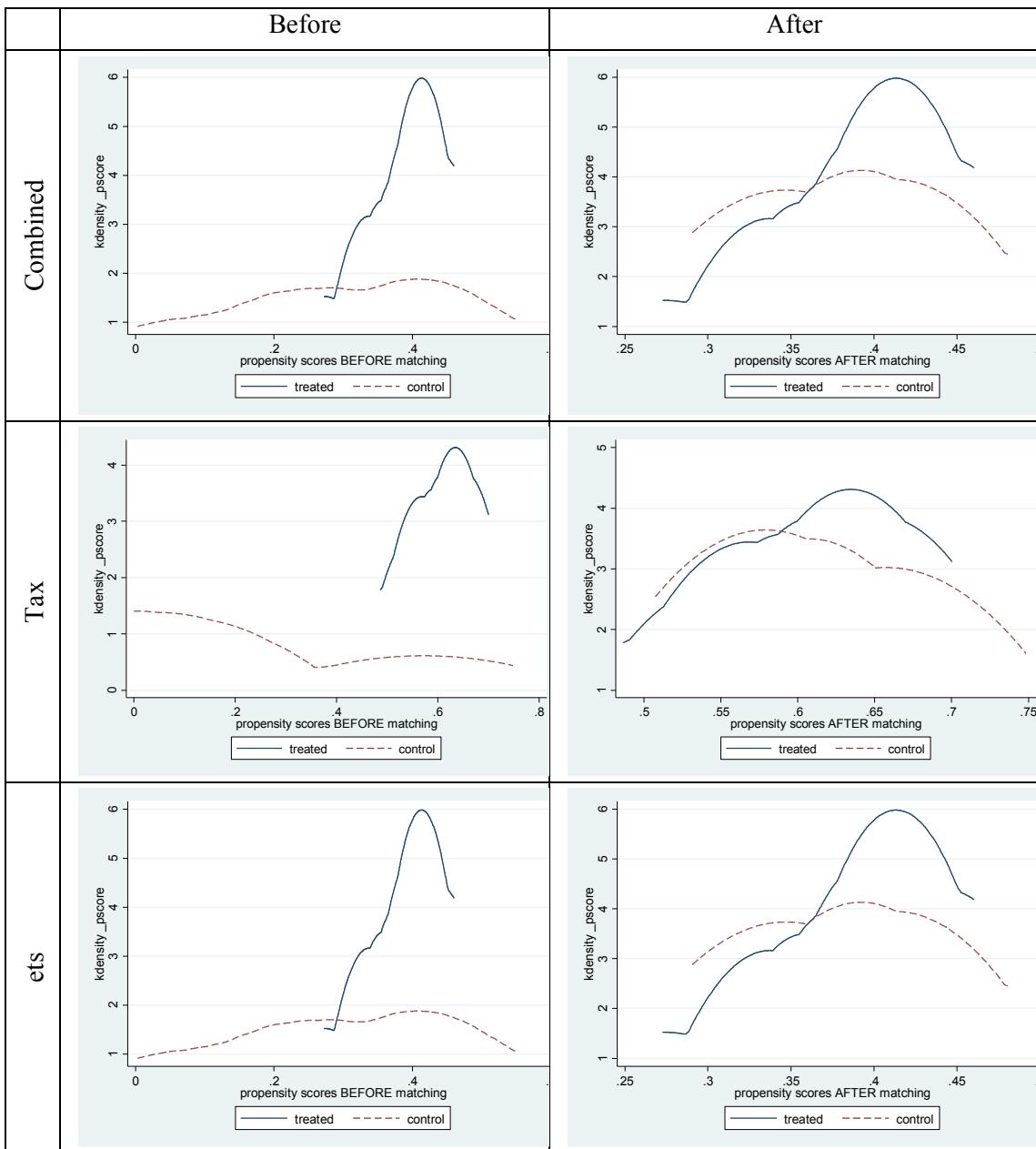
an extended common support area and a balanced score. The common support zone is quite extensive here, a sign of good comparability between the groups, since between [0.48663187 0.72935366] for the combined mechanisms, between [0.32328009 0 .70017124] for the carbon tax and [0.2727751 0.46011684] for the quota systems. Below and beyond these limits, there are no counterfactuals. The propensity score was estimated for all countries, but countries not in the common support area are excluded from the analyzes.

5.1.2. Matching

L'appariement sur score de propension renvoie à l'appariement des pays des groupes traité et de contrôle possédant des valeurs de score de propension proches ou similaires, et écarte les pays non appariés. Les méthodes d'appariement tentent de jumeler chaque pays traité avec un ou plusieurs pays non traités dont les caractéristiques observables sont les plus proches possibles. L'objectif de l'appariement est de construire un groupe témoin comparable au groupe traité affin de permettre une estimation non biaisée de l'effet du traitement sur les individus traités, en contrôlant le biais de sélection [24] [25] [26] [27] [28] [29].

Before matching, many of the countries in the control group have a higher propensity score than the countries in the treated group. Since the propensity score is a probability of belonging to the treated group given the chosen characteristics, countries with a propensity score close to 1 naturally have a better chance of belonging to the treated group. The following figure represents the distribution of the propensity score before and after matching. The distribution is symmetrical, indicating that the matching made the countries in the two groups comparable. The result of the matching operation was the creation of two groups: treated countries and control countries with a similar propensity score distribution, as shown in Figure 2.

Figure 1. Matching



5.1.3. ATET

The time-varying results of estimating different matching methods on different GHG emission reduction schemes (which are presented in Table 4.6 above) allows observing a positive and significant impact on the stimulation of reduction of co2 emissions. This result coming from the study of the effect of the treatment which is carried out in a dynamic mode seems very interesting. These results prove that these instruments are effective in reducing CO2 emissions.

The ATE is the average treatment effect and the ATET is the difference between the results of the treated countries and the results of the treated countries if they were not

treated. Four techniques are used Nearest neighbor matching, Radius matching, Kernel Matching and Stratification Matching the results are shown in the following table :

Table 3 : results

method	COMB		ETS		TAX	
	2018-2006		2018-2006		2005-1996	
ATE	-18257.53	-2.824*	-21328.81	-2.720*	-9257.02	-2.925*
ATET NN	-21900	-3.986*	-29900	-2.186**	-8292.310	-2.361**
ATET RM	-20200	-3.522*	-23600	-1.876**	-8064.039	-1.938**
ATET KM	-18800	-3.251*	-25400	-2.123**	-8378.508	-2.348**
ATET SM	-20800	-2.266**	-22000	-1.840**	-8292.310	-1.858**

*1% **5%

The results of the four estimation techniques showed a dominance of the emissions trading system (ETS) which allowed a reduction between 22000 and 29900 kt. The carbon tax remains ineffective, it has practically led to a reduction of four times less than that of the emissions trading system (ETS), i.e. between 8064 to 8378 kt. The use of the two combined systems is significant but in terms of reduction it is clearly more effective than the carbon tax but less effective than the emissions trading system (ETS) the total emissions reduced by the use of two combined systems ranging from 18800 to 21900 kt. The difference in terms of reduction of emissions by the ATE method showed a decrease ranging from 9257kt, 18257kt to 21328 kt successively by the carbon tax, combined instrument and ETS.

In this study, we have examined the effectiveness of policy instruments to reduce CO2 emissions in a basket of countries belonging to the OECD. Unlike previous studies, we implemented a non-parametric approach, the propensity score. The matching results suggest positive and significant effects on the reduction of CO2 emissions. However, the effectiveness of the instruments differs. Even here the carbon tax is not in its infancy in the economies of the European Union.

Since carbon taxes are important policies for reducing CO2 emissions, nevertheless their impact remains insignificant and these policies alone will not be sufficient..

This transformation requires the long-term collective commitment of all stakeholders, including governments, citizens, financiers, private companies and international bodies. In addition, international cooperation can strengthen global efforts to reduce carbon emissions and accelerate the adoption of climate policies by assessing the compatibility between them through effective regulatory mechanisms..

6. Conclusion

Considered as one of the methods of CO2 mitigation, carbon tax can reduce energy consumption, improve energy efficiency and Developed renewable energy. Of course, the carbon tax also has its flaws. For example, it will affect the economy, decrease social welfare, competitiveness of industries and lead to carbon leakage. Motivated by the controversial question of the real effect of the carbon tax in the mitigation of

carbon emissions, we try to estimate its effects in the countries of the European Union which have adopted this policy, using the scoring method. of propensity. our paper focuses on the actual mitigation effects during the carbon tax implementation period and tries to offer more information to decision makers by analyzing the results.

The mitigating effect of the carbon tax differs from one country to another. On average, the coefficients for the countries adopting the carbon tax are positive, but none of them exceeds the criterion of importance, showing the limited effects of the carbon tax in these countries.

The different impacts of carbon tax in different countries mainly come from different carbon tax rates, scope of tax exemption, and different use of carbon tax revenue. The environmental externality requires a uniform tax rate for different sectors, which is also why the carbon tax in some countries e.g. Finland works better than other countries, even though the tax rates nominal values are generally lower.

Considering the effects of the carbon tax on industrial competitiveness, some countries such as Sweden, and Denmark have granted tax exemption to manufacturing and energy-intensive industries which have reduced the mitigation effects of the carbon tax in these countries.

Furthermore, the experience of Denmark indicates that, compared to the direct use of carbon tax revenues as part of tax revenues, recycling tax revenues to companies for environmental purposes can promote energy development. renewables by offsetting the costs Induced by the tax exemption.

In Sweden, even though all of its carbon tax revenue is included in tax revenue, its relatively high carbon tax rate has made the mitigation effects better than those of Denmark, Estonia, Latvia or Poland.

Faced with the serious problem of climate change, the choice to reduce CO₂ emissions and pursue low-carbon development has become inevitable. it is suggested that adjusting industrial structure, increasing R&D investment and raising energy prices are reasonable choices for reducing CO₂ emissions. In addition, for countries that are required to levy a carbon tax, implementing a flat tax can effectively reduce CO₂ emissions. However, when implementing differential tax rates in order to avoid a loss of industrial competitiveness, it is necessary to embed the revenue from carbon tax revenues on environmental measures or to increase carbon tax rates. to mitigate the effects of the carbon tax.

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Information Technology Governance Implementation and Its Determinants in the Egyptian Market

Nariman O. Kandil, Ehab K. Abou-Elkheir, Amr M. Kotb

Abstract— Effective IT governance guarantees the strategic alignment of IT and business goals, risk mitigation control, and better IT and business performance. This study seeks to examine empirically the extent of IT governance implementation within the firms listed on the Egyptian stock exchange (EGX30) and its determinants. Accordingly, 18 semi-structured interviews face to face, phone, and video-conferencing interviews using various tools (e.g., WebEx, Zoom, and Microsoft Teams) were undertaken at the interviewees' offices in Egypt between the end of November 2019 and the end of August 2020. Results suggest that there are variances in the extent of IT Governance (ITG) implementation within the firms listed on the Egyptian stock exchange (EGX30), mainly caused by the industry type and internal and external triggers. The results also suggest that the organization size, the type of auditor, the criticality of the industry, the effective processes & KPIs, and the information intensity expertise of the CIO have a significant impact on IT governance implementation within the firms.

Keywords— Effective IT Governance, Egyptian Market, Information Security, Risk Controls

I. INTRODUCTION

With the increase in the reliance on IT and the associated growth of IT expenditure, the idea of ITG has become an increasingly common and prominent ideal within most organizations to ensure prudent and value-based investment in the technology [1], [2]. IT Governance (ITG) consists of structures, processes, and

relational mechanisms that work together in harmony to ensure that IT investments and business objectives are aligned [3]. The foundation of ITG is to provide decision-makers an acceptable level of assurance that an organization's strategic objectives are not jeopardized by IT failures [4].

In this respect, the aim of this paper is to critically explore the extent of ITG implementation within the firms listed in the Egyptian stock exchange and its determinants. The main objective of this critical exploration is to provide insights about the extent of ITG implementation within the Egyptian market and ITG various determinants through the employment of a semi-structured interview approach with ITG professionals.

Following this introduction, the paper is structured as follows: theoretical background, then the research method, discussion and results and conclusions.

II. THEORTICAL BACKGROUND

ITG is considered a complex system as it comprises several critical aspects, namely, "leadership, organization and decision rights, scalable processes and enabling technologies" [5]. Early conceptualizations of ITG, often considered as a subset of corporate governance [6], [7]. The role of ITG is recognized in ensuring a valuable contribution from the organization's IT to its overall business strategy [8].

Nariman O. Kandil is with the German International University, Egypt (email: nariman.osama@giu-uni.de).

Ehab M. Abou-Elkheir is with German University in Cairo, Egypt (e-mail: ehab.kamel@guc.edu.eg).

Amr M. Kotb is with the Zayed University, United Arab of Emirates, (email: Kotb.Amr@gmail.com).

ITG has been demanded by many organizations and high-level ITG models are being used within the organizations and rapidly emerging in IT, thus becoming an important subject to consider [9]. So far, some ITG frameworks have been developed to guide and assist ITG implementation.

It is notable that there is a research shift from the technological aspect of IT into the business aspect of IT [10]. This is reflected by extensive research on the governance of IT in multiple countries. Though, most of these countries are developed ones with little research on the developing countries. Hence, the drive for ITG implementation within the developing countries especially Egypt remains mostly unexplored.

III. RESEARCH METHOD

To achieve a comprehensive understanding and better scan the degree of ITG implementation within various companies in the Egyptian market, this study follows [11]. Qualitative design methodology in which it assists in answering our two main research questions which are: (1) To what extent ITG is implemented in the firms listed in the EGX30? (2) What are the determinants affecting the ITG implementation in the firms listed in EGX30?

A. Sample Selection

This study includes a non-probability random sampling approach as adopted from [12].

Based on the nature of the study, the sample group selected for this study consists of professionals that work in the field of ITG within the firms listed in the Egyptian stock exchange (EGX 30). The experience level of this sample varies, ranging from governance

subject matter experts (directors) to C-level executives. Additionally, the length of service in the profession and/or industry is varied and ranged from six to thirty-one years. And there is a mixture of professional expertise and qualifications. Although, age is not a consideration for this research, the sample consisted of professionals between the ages of 30 to 65. Demographics of this sample comprise professionals from the following industries:

- Financials
- Real Estate
- Chemicals
- Manufacturing
- Healthcare
- Construction
- Communications
- Energy

B. Data Collection

Over a period of ten months, from end of November 2019 to end of August 2020, a total of eighteen interviews were carried out across range of genders, ages, positions, and types of long-term experiences within the Egyptian market over IT directors, managers, and CIOs.

In addition to the primary data collection method used in terms of the semi-structured interviews, other secondary data is also obtained using the annual reports and corporate websites.

C. Reliability and Validity of the interview

To attain reliability, the study must be able to endure several tests by other researchers and reach the same results [13].

As for the concept of validity, it is concerned with an instrument's ability to answer questions or measure what it says it measures [14].

D. Data Analysis

The recommendations highlighted by [15]. In which the methodology of the data analysis of this study are adopted.

Within this study, 18 interviews are tape recorded along with some observation notes are taken during the interview. Immediately, following each interview session, the researcher listens to the verbal responses on the recordings, and then transcribes and places the data a Microsoft Word format. Hence, all transcripts are prepared in English, except for only one interview is translated from Arabic to English and then transcribed.

After the transcripts are completed, a preliminarily analysis is taken place to identify some common themes. After all the interviews are complete, the coding phase took place. During this time, the researcher goes through the interview data on several occasions to develop a better understanding of ITG. Moreover, the researcher assigns code (a name to each participant) to ensure anonymity and confidentiality e.g. (A) is for the first interviewee [16]. Afterwards, the researcher reviews each transcript and highlights the most prominent statements and neglects any irrelevant points to the purpose of the research [16].

During the data analysis process, several themes, patterns, and connecting relationships emerged that create a need for additional analysis to find commonality across various data sources.

Based on the themes and patterns detected, the data are cross-checked and summarized multiple times to guarantee reliability [14]. The themes are organized based on their frequency and categories. This is followed by the final analysis and the step of writing up (reflective journaling technique). Within the writing up process, each theme is reinforced by a wide range of quotations that are the most prominent and remarkable ones within each theme. The reflective journaling technique aids the researcher to tackle any unclarified thoughts and perceptions associated with ITG.

IV. RESULTS AND DISCUSSIONS

In their journey to implement and further develop ITG, organizations are confronted with a set of challenges and diverse problems. Accordingly, to further examine the extent of ITG implementation within the companies listed on the Egyptian stock exchange, we ask our study's participants across 8 different industries within the Egyptian market regarding their perceptions about ITG implementation in practice as illustrated in figure (1). The chief information officer of a financial services organization opines: "*ITG with all its aspects is implemented with clear governance and strict policies for how they run the bank and how they change the bank, financial governance, project delivery governance and risk, information security governance and vendor management governance are also implemented.*"

Similarly, the IT director of a telecommunication company highlights that ITG is vastly implemented on each aspect within IT whether financial, change management, risk, security, data, project delivery and systems availability governance; as he cites regarding the implementation of systems availability governance aspect: "Due

to the sensitivity of the business, ERP Systems (Oracle) are running with a great percentage up to 99.999%.”

While the IT directors for the energy and construction companies reveal: “*ITG is implemented within the company with a percentage of 75%.*” The IT directors for healthcare, pharmaceuticals and manufacturing organizations summarize: “*ITG is implemented within the company with a percentage of 60%.*” As for the remaining sectors (real estate and chemicals), according to the interviewees, the extent of ITG implementation is low in comparison to the prior sectors which will be further explained.

It is revealed that there a lot of discrepancies in the degree of ITG implementation within the companies listed in the Egyptian market, which is mainly caused by the industry type, internal and external triggers (illustrated later). For instance, based on the former answers of the interviewees, it is found that the degree of ITG implementation within the financials and the communications is very high as they are grouped within high tier IT industries (highly IT dependent) in compliance with [17]- [21]. In which the strategic role of IT is transformational one (creating a full entire change within the organization) as cited in [22], and the criticality of their industries.

Surprisingly, it is notable that ITG is implemented to a great extent with its various aspects within the communications company; nonetheless it is deliberated as publicly seized company. This can be explained to the positive impact that ITG has on the decision making within organization and the criticality of the industry (in terms of telecom); resulting in improved business operations at the end that agrees with [23], [24].

Moving to the extent of ITG implementation within energy and construction (even though they are critical industries), it is shown that the degree of ITG implementation is above average as they are both categorized within low tier IT industries in which the strategic role of IT is informative as cited in [25].

As for the extent of ITG implementation within the manufacturing, healthcare & pharmaceuticals, despite the differences in the grouping of the industries within IT tier industries and the strategic role of IT, it is reflected that the degree of ITG implementation is average. This extent of ITG implementation within the manufacturing as average matches with [25].

Interestingly, another significant argument is underlined about the degree of ITG implementation within healthcare & pharmaceuticals which is despite the categorization of healthcare & pharmaceuticals among high tier IT industries in which the strategic role of IT is transformational one; the degree of ITG implementation is average contradicting with [17], [19], [26]. Due to the lack of a very crucial aspect within ITG which is change management governance violating the study of [27], and other triggers (discussed later). Moreover, it is added that healthcare & pharmaceuticals industry is not as critical as the financials and communications and their IT budget size is not as huge as the financials and communications.

Moving to the degree of ITG implementation within real estate and chemicals, it is remarkable that the degree of ITG implementation is not as high as the other sectors supporting with [25]. Bearing in mind

that they are both classified among low tier IT industries and the strategic role of IT is informate.

As an example, for the extent of ITG implementation in chemicals, the IT director of a chemical company commented: "*Usually there are two main restrictions related to ITG implementation within our public sector organization which are decision making authority and the budget.*" Hence, it is inferred that the decision-making authority and IT budget related decisions are two main challenges that may affect ITG implementation within the public sector organization in fulfillment with [2].

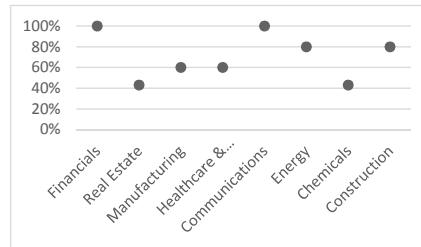
An interesting fact to outline is the variations in the degree of ITG implementation between the companies within the same industry. So, within the real estate sector, the degree of ITG implementation in small medium sized companies (SMEs) is lower than huge organizations in proportion to [28]- [32], caused by some triggers will be exemplified in detail.

As formerly discussed that there are discrepancies in ITG implementation across the 8 different industries within the Egyptian market, thus, ITG is highly implemented within the financials and communication sectors due to the criticality of both industries, the massive organization size (measured by the number of employees), the gigantic size of IT budget, Big 4 auditor type (with referral to the annual reports), effective processes, IT performance monitoring measurements (KPIs), the information intensity expertise of the CIOs.

Nonetheless, it is found that there are some triggers for ITG implementation restricted to

the financial sector only which are the presence of IT steering committees on board, private ownership and legal requirements imposed by the Central Bank of Egypt. Since it is worthy to mention that all formerly discussed ITG practices within the financials are compulsory; in which they are incorporated within the regulations of Central bank of Egypt.

Fig.1 ITG DEGREE OF IMPLEMENTATION



While the degree of ITG implementation within energy and construction sectors are above average (as perceived by the participants) caused by the cruciality of both industries, huge organization size (measured by the number of employees), Big 4 auditor type (by referral to the annual reports), huge size of IT budget, privately sized, the existence of IT steering committees on board, effective processes, IT performance monitoring measurements (KPIs), and the information intensity expertise of CIOs. On the other hand, it is deductible that the board's knowledge about ITG matters is highly amplified within the construction sector only due to the sensitivity of the industry as it is considered one of the fundamental pillars of the national economy.

Along the road, it is revealed that the extent of ITG implementation within the

manufacturing, healthcare & pharmaceuticals attributed to some common factors which are the huge organization size, Big 4 auditor type, huge size of IT budget, privately sized, effective processes, IT performance monitoring measurements (KPIs), and information intensity expertise of the CIOs. Even though, it is concluded that there are some variations in the attributes of ITG between both sectors. As an example, the existence of IT steering committees on board is only restricted to the manufacturing sector. However, the weight of the board's knowledge among ITG matters is amplified within healthcare & pharmaceuticals as they are classified among high tier IT industries (heavily IT dependent industry); in which IT is extensively used within its whole operations.

Remarkably, the absence of IT steering committees on board within the health care & pharmaceuticals promotes a significant venue for discussion as they are grouped within high tier IT industries conflicting with the studies of [31], [33], [34], [35].

It is significant to mention the reasons for the differences in the extent of ITG implementation among the companies within the manufacturing sector (FMCGs and Steel).

The degree of ITG implementation within the steel manufacturing is higher due to the criticality of the business industry, the presence of IT steering committees on board and the variations in the organization size. Lastly, the low degree of ITG implementation within the real estate and chemicals in comparison to other sectors is affected by the absence of IT steering committees on board within both sectors, the degree of cruciality of both industries, the size of IT budget, the ownership structure, the degree of formalizing

the processes and the information intensity expertise of the CIOs compared to prior sectors.

Additionally, it is reflected that the variation among the companies within the real estate sector can be reasoned to multiple attributes which are the differences in the organization size (measured by the number of employees), the small size of IT budget, the less structured IT department, the strategic role of IT as an executive of a real estate company noted: "*Alignment of IT and business is not an accurate definition for ITG, IT is considered to be a supporting function*", the limited information intensity expertise of the IT director, lack of formal processes as ITIL and ISO27001 which is considered one of the central factors for an effective ITG implementation and poor knowledge of ITG matters among CEOs of SMEs.

TABLE 1 ITG DETERMINANTS

Industry type	Industry criticality	Firm size	Big 4 auditor	Huge IT budget	Private Ownership	IT steering committees	Processes	KPIs	Information expertise	Board's Knowledge	Legal requirements
Financials	√	√	√	√	√	√	√	√	√	-	√
Real Estate	-	√	√	√	√	√	√	√	√	-	-
Manufacturing	-	√	√	√	√	√	√	√	√	-	-
Healthcare& Pharmaceuticals	-	√	√	√	√	-	√	√	√	√	-
Communications	√	√	√	√	-	-	√	√	√	-	-
Energy	√	√	√	√	√	√	√	√	√	-	-
Chemicals	√	√	-	-	-	-	√	√	√	-	-
Construction	√	√	√	√	√	√	√	√	√	√	-

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Appendix: Interview Guide

1-How many years of experience do you have in your current position?

2-What is your role within the relevance of information technology function?

3-Can you please tell me the hierarchy levels of IT within the organization?

4-In the previous financial year, what was your organization's annual IT budget as a percentage of the annual revenue?

5-Within your organization, what is the total number of employees?

6-Within your organization, what is the total number of employees working in the IT department?

7-What does ITG mean to you personally?

8-To what extent ITG is implemented within your organization? And can you please tell me about some examples for the ITG implementation?

9-How ITG is developed over the past years within the company?

10- Can you please tell me about the differences between the ITG implementation in your current organization and your previous one, if accessible?

11- In your opinion, how far does ITG affect the performance of the IT department and the business/organization performance?

12- Is it possible to clarify whether ITG is disclosed in the annual reports or not?

13- within your organization, what are the determinants affecting the level of ITG implementation?

14- Can you please rank the importance of the determinants affecting the level of ITG implementation and why?

15- How does COVID-19 affect the digital transformation within the firm?

16- After the pandemic, what are the lessons learnt within the information technology function?

Adaption to Climate Change as a Challenge for The Manufacturing Industry – Finding Business Strategies by Game-Based Learning

Sophie Fischer, Jan Schmitt

Abstract—After the Corona pandemic, climate change is a further, long-lasting challenge the society must deal with. An ongoing climate change need to be prevented. Nevertheless, the adoption to the already changed climate conditions has to be focused in many sectors. Recently, the decisive role of the economic sector with high value added can be seen in the Corona crisis. Hence, manufacturing industry as such a sector, needs to be prepared for climate change and adaption. Several examples from the manufacturing industry show the importance of a strategic effort in this field: The outsourcing of a major parts of the value chain to suppliers in other countries and optimizing procurement logistics in a time-, storage- and cost-efficient manner within a network of global value creation, can lead vulnerable impacts due to climate-related disruptions. E.g. the total damage costs after the 2011 flood disaster in Thailand, including costs for delivery failures, were estimated at 45 billion US dollars worldwide. German car manufacturers were also affected by supply bottlenecks and have close its plant in Thailand for a short time. Another OEM must reduce the production output.

In this contribution, a game-based learning approach is presented, which should enable manufacturing companies to derive their own strategies for climate adaption out of a mix of different actions. Based on data from a regional study of small, medium and large manufacturing companies in Mainfranken, a strongly industrialized region of northern Bavaria (Germany) the game-based learning approach is designed. Out of this, the actual state of efforts due to climate adaption is evaluated. First, the results are used to collect single actions for manufacturing companies and second, further actions can be identified. Then, a variety of climate adaption activities can be clustered according to the scope of activity of the company. The combination of different actions e.g. the renewal of the building envelope with regard to thermal insulation, its benefits and drawbacks leads to a specific strategy for climate adaption for each company.

Within the game-based approach, the players take on different roles in a fictional company and discuss the order and the characteristics of each action taken into their climate adaption strategy. Different indicators such as economic, ecologic and stakeholder satisfaction compare the success of the respective measures in a competitive format with other virtual companies deriving their own strategy. A "play through" climate change scenarios with targeted adaptation actions illustrate the impact of different actions and their combination on the fictional company.

Keywords—business strategy, climate change, climate adaption, game-based learning

Sophie Fischer is Scientific Assistant at the Institute Digital Engineering (IDEE) University of Applied Sciences Würzburg-Schweinfurt (FHWS), 97421 Schweinfurt, Germany (e-mail: xeniasophie.fischer@fhws.de).

Jan Schmitt is Professor at the University of Applied Sciences Würzburg-Schweinfurt (FHWS), 97421 Schweinfurt, Germany. He is now head of the Institute Digital Engineering (IDEE) of the FHWS (e-mail: jan.schmitt@fhws.de).

Hybrid Image of Multiple Fantastical Characters

Juhapekka Ollikainen

Juhapekka Ollikainen is with the in Independent Scholar, Finland (e-mail: pekollik@gmail.com).

#creative coding #computational creativity #creativewriting#roleplayinggames#python#scripting

In the future, there will be more and more possibilities to create new stories, games, and comics from the existing public domain characters. Each and every year tens and hundreds of the story segments, characters, and their characterizations opens up for designers and developers of digital media of all kinds. New copyright schemas will be developed due to the standardization of open Internet and mobile technologies. On the other hand, creative writing communities, e.g. those of the global fan fiction developers may also have their word to say on how public domain and legacy stories should be used in the creative works.

Both Internet technologists, as well as digital creatives, need new tools and schemas for how to handle and distribute these new open media assets for fiction and storylines of all sorts.

By using the methods of both creative coding and computational creativity as well as by carefully studying existing story archives, eg. text corpora of folk stories we are hoping to create a scriptable platform to nurture creativity in-game character and storyline design. The outcome of the study and research will be a hybrid image of multiple fantastical characters, including 3D models and Python scripts to generate storylines. Python scripts can be used in conjunction with open source 3D systems such as Blender via Python Blender API.

We're getting started by printing new types of 2D paper models and 3D models on the desktop role-playing platform, e.g., Hero Quest. The idea here was to use a text corpus as a source, e.g. Kalevala, and create a platform that allows you to print eg heroic characters that combine the features of human, spiritual, and animal characters in the Kalevala with the help of various random algorithms.

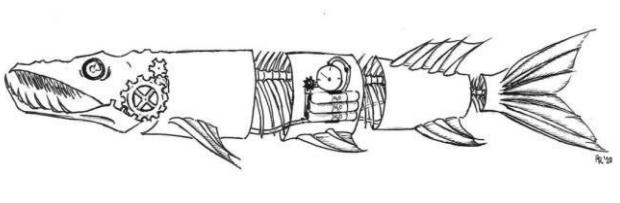


Figure 1 *Kalevala (hybrid) Suomuhauki* as illustrated by our graphical artist.

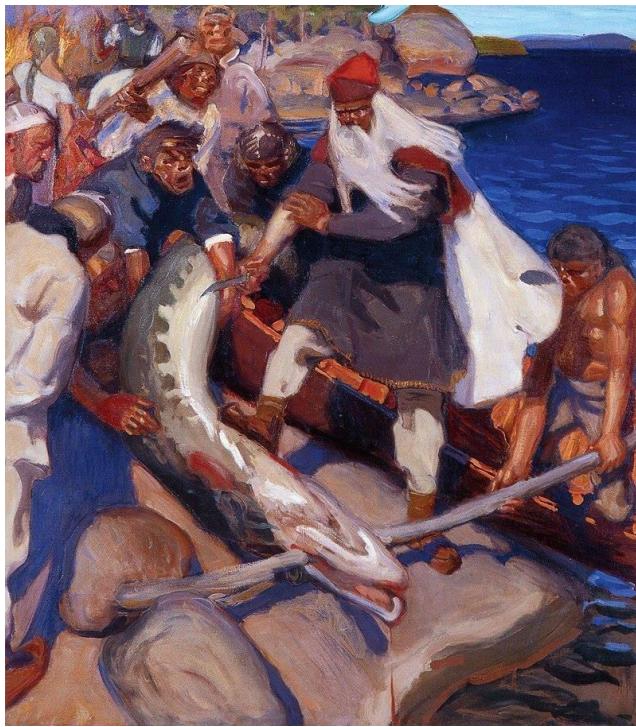


Figure 2, Akseli Gallen-Kallela: *Iso hauki* (1909).

The prototype of the system is implemented in the Python programming language. There is a small Python program ready to present the idea of a public domain adventure character generator like this. I can background my presentation with a brief literature review of scratch/cut-up techniques. And on the other hand, there are also some visual ideas about how such a system could be utilized in practice, for example in game design.

To whom? game designers for writing game characters for video games as well as designers creating character classes for RPGs both video and board games. The system can be also useful for inspiration to 3D Modelers designing and printing game characters for board games as well as role-playing board games such as Hero Quest.

Technologies to be used in 3D? technologies for prototyping public domain hybrid characters creation at 3D: 3D modeling software,(Tinkercad, Blender), CAD on the cloud (OneShape) scripting the scenarios (Python)

How to continue? The system requires experimentation and testing in a workshop e.g. with sci-fi/creative writers and/or game design/game coders, as well as, above all, the making and testing of 3D models in various game environments (Hero Quest, Minecraft?).

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An Analysis of How Students Perceive Their Self-Efficacy in Online Speaking Classes

Heny Hartono, Cecilia Titiek Murniati

Abstract— The pandemic has given teachers and students no other choice but having full online learning. In such an emergency situation as the time of covid-19 pandemic, the application of LMS (Learner Management System) in higher education is the most reasonable solution for students and teachers. In fact, the online learning requires all elements of a higher education systems including the human resources, infrastructure, and supporting systems such as the application, server, and stable internet connection. The readiness of the higher education institution in preparing the online system may secure those who are involved in the online learning process. It may also result in students' self-efficacy in online learning. This research aimed to investigate how students perceive their self-efficacy in online English learning, especially in speaking classes which is considered as productive language skill. This research collects qualitative data with narrative inquiry involving 25 students of speaking classes as the respondents. The results of this study show that students perceive their self-efficacy in speaking online classes as not very high.

Keywords— Self-efficacy, online learning, speaking class, college students, e-learning

Heny Hartono is with the English Department, Faculty of Language & Arts, Soegijapranata Catholic University, Indonesia. She is now the Director of Teaching & Learning Center, SCU (e-mail:heny@unika.ac.id)

Cecilia Titiek Murniati is with the English Department, Faculty of Language & Arts, Soegijapranata Catholic University, Indonesia (e-mail: c_murniati@unika.ac.id).

Play-based Learning is Beneficial for the Learning and Development of Young Children in an Early Years Education Context from Perspectives of Mathematics Learning Attainment, Linguistic Capabilities and Social Skills

Shuting Deng

Shuting Deng is with the in Glasgow University, United Kingdom (e-mail: 3092241979@qq.com).

Abstract: The use of play as a pedagogical approach in early learning is highly contested. Such debate is central to the pedagogical practices in the early years education. The essay contends that play-based learning is beneficial for the learning and development of young children in the early years education landscape. The argument is underpinned by three claims, that is, play-based learning helps enhance children's mathematics learning achievements, play-based learning helps enhance children's linguistic capabilities, and play-based learning helps enhance children's social skills. As an effective pedagogical approach benefiting the learning and development of young children, play-based learning has significant implications for employing play in the early years education practices. The benefits of play-based learning help inform policy examination and making regarding the application of a play-based curriculum in preschool and early primary schooling. Relevant studies provide ample reference for future research evaluating the role of play in the early years learning.

Keywords: Play; Play-based Learning; Pedagogy; Early years education

1. Introduction and context

Early years education (EYE), generally covering children aged three to eight, is a distinctive and critical learning stage. A widespread movement nationally and internationally has called for a unique type of curriculum and pedagogy that fit with the development of young children to improve their education experiences (Bertram and Pascal, 2002). Central to EYE is the need to develop a unified educational approach to early years provision that helps lay a solid foundation for subsequent education stages and prepares young children for more sophisticated school learning (Walsh *et al.*, 2010). New discourses in the education landscape re-articulate the expectations for young children and their learning experiences in preschool and early primary schooling. Education policy agendas at national and international levels seek to enhance academic achievements and educational accountability, which leads to increasing emphasis on teacher-led learning in EYE (Hesterman, 2018). Resulting tensions surrounding the decline of play and the quality of teaching and learning in EYE arise (Barblett *et al.*, 2016). Many countries have expressed concern regarding the “alarming disappearance of play” in kindergarten and preschool educational practice (Nicolopoulou, 2010: 1).

As a quality educational approach for actively engaging children in their learning, play is fundamental and critical to the development of young children. However, growing demands to formalise EYE and increasing social pressures on schools for accountability and enhancing academically-oriented

performance have resulted in less time for young children to participate in play in schooling and increased the risk of eliminating play as a pedagogical method from EYE (Ang, 2014). This trend reinforces the image of preschool pedagogy as an either-or choice between formal early learning with a focus on school readiness and free child-led play nearly without adult intervention (Bubikova-Moan *et al.*, 2019). The formal approach is dominated and led mainly by teachers, and teaching and learning are repetitive practices aimed at mastering subject knowledge and competencies. In contrast, a child-led play approach enables children to be active agents in their learning rather than passively receive knowledge and the teachers to be facilitators instead of didactic knowledge providers. The tensions between the two approaches are related to the child-centred or teacher-driven educational question and concerns about the relationship between learning and play. Perceived binary relation between learning and play has led to pressures in EYE, and a new approach to EYE addressing the issue has become an imperative (Dealey and Stone, 2018).

In this context, play-based learning (PBL) is a suggested curriculum and pedagogical approach in the EYE landscape. Advocating learning through play and acknowledging the indispensable role of the adult in the development of young children, such an approach realises a balance between the autonomy of children and instructions from teachers. Although it is a broad acknowledgement that a combination of play and viable educational pedagogies lies at the centre of PBL, there is no consensus on the definition of PBL (Bubikova-Moan *et al.*, 2019). The meaning of PBL adopted in this paper is based on the following concepts of guided play and play-based curriculum. Including playing opportunities and learning with guidance and providing a balanced dynamic of free play and direct instructions, guided play is somewhere curricular goals meet playful pedagogy and an ideal state of PBL (Weisberg *et al.*, 2013). A play-based curriculum, according to Van (2013: 516), is not a “prescriptive syllabus” that teachers have to follow daily but is constructed by the teacher based on their interaction with the children in the classroom and the considerations of their formal teaching objectives; it is informed by the learning needs and interests of children but is not “laissez-faire”.

In the latter sections, the paper presents an evidence-based articulation of how PBL is beneficial to the learning and development of young children in the EYE context from three perspectives, mathematics attainment, linguistic capabilities, and social skills.

2. PBL helps enhance children's mathematics learning achievements

In their comprehensive scoping review of 74 studies that examined the role of play in learning achievement, Pyle *et al.* (2017) concluded that extensive evidences have shown that a play-based approach to mathematics education helps improve children's mathematical competencies such as number sense, spatial ability and logico-mathematical reasoning. An empirical intervention study conducted by Vogt *et al.* (2018), which examined how a teacher-led training programme and a play-based pedagogical approach affect the mathematical competency of children in Swiss kindergartens, also contributes to the body of evidence regarding the benefits of PBL in children's mathematics learning. The paper elaborates their research as follows.

The study employed a pre-post-test quasi-experimental design with eight weeks of intervention. The research sample included 111 children in the intervention group participating in the teacher-led training programme, 91 children in another intervention group adopting the play-based pedagogical approach with card and board games, and 127 children in the control group. The involved kindergartens were randomly selected and assigned to one of the groups. The comparability of the three groups was proved by repeatedly measuring the variance on factors such as the children's cognitive ability, family socioeconomic status and pretest mathematical competencies, which helped ensure the credibility of mathematical learning outcomes impacted by various treatments. By comparing the mathematical competencies of the three groups at pretest and post-test, the quantitative research found that the play-based intervention group attained higher learning gains than the other two groups (see Table 1). The research result indicated that children in the play-based intervention group performed much better than their peers treated with traditional pedagogical practice in the control group, and the play-based pedagogical approach is more effective than the instructional and teacher-led training programme.

Table 1. Data of mathematical competencies of three groups at pretest and post-test and their learning gains [source: redrawn from Vogt *et al.* (2018)].

	M (SD) pretest	M (SD) post-test	M (SD) learning gains
Play-based	63.89 (17.14)	75.24 (17.59)	11.35 (9.15)
Training programme	65.21 (19.78)	74.25 (17.89)	9.05 (8.70)
Control	60.58 (17.89)	68.59 (18.01)	8.02 (7.87)

At the end of the interventions, independent researchers conducted semi-structured interviews with educators from the participating kindergartens regarding their views on the interventions and pedagogical preferences. According to the analysis of the qualitative data from the transcript of the interviews, the study found that educators considered the play-based approach more suitable for meeting the diverse learning needs of young children. Also, researchers discovered that practitioners are more passionate about the play-based intervention and predicted that their positive attitude about it might contribute to the successful academic achievements of the children in the study. The findings from this research project provide empirical evidence regarding the positive effect of PBL in early mathematics education.

In addition to evidence from Switzerland, a socioeconomically higher developed country, evidence from Palestinian also came to the same conclusion. Murtagh *et al.* (2022) analysed part of the data from a research project evaluating the impact of PBL on mathematic subject knowledge of students in Palestinian primary schools (Turshan, 2019) to answer their research question, whether primary school children taught with a PBL pedagogical approach achieve better academic outcomes in mathematics exams than their peers treated with traditional education practices. The original parallel study was conducted in the 2018 and 2019 academic years. The recruited 12 primary schools came from marginalised rural areas in Palestine, and the participants are students in grades 1-4 from those schools. The intervention group had eight schools, and the control group had four schools comparable to the contextual aspects of the intervention group, such as teacher quality and experience. Both groups consisted of four classes at each grade level and had a similar amount of students. The initial data was mathematics test scores from school-based assessments at the end of each term. Tests for evaluating the achievement of learning outcomes were developed by a group of professionals in mathematics education. Murtagh *et al.* (2022) used and analysed data gathered from two academic terms, September to December in 2018 and from February to April in 2019, with 859 and 832 students attending the test in each. The data in the latter term was considered missing totally at random and did not need attribution. According to their finding, the intervention group achieved significantly higher mean test scores in both terms than the control group, suggesting that children in schools implementing play-based pedagogies attained better academic performance in mathematics learning, and the PBL approach to early mathematics education has a positive impact on children's academic attainment.

Besides the evidence from Palestine, a two-year play-based programme called Big Math for Little Kids involving children aged from four to five in low-income communities in New York (Lewis Presser *et al.*, 2015) also showed that PBL is helpful for young children to acquire and build up mathematics knowledge. Here, different evidences come together to support the claim that PBL help enhance children's learning achievements in early mathematics education.

3. PBL helps enhance children's linguistic capabilities

Play-based educational settings enable children to communicate and interact and build richer meaning networks of the world, and as children engage in play-based activities that stimulate their interests, they have new learning needs for expressing their opinions and queries (Van, 2013). PBL environment, in this sense, creates ample opportunities for early language development. Vocabulary is

one of the vital parts of the language. Empirical evidence from the Netherlands (Duijker, 2003), which suggests that a play-based curriculum is beneficial for vocabulary acquisition and building and extending the semantic network, supported the positive impact of PBL in vocabulary development. The paper presents it in detail as below.

Duijker (2003) carried out a comparative study to examine the vocabulary learning outcomes of children from two different primary schools in an urban area in the Netherlands. One school used a teacher-driven approach (T-school), and the other implemented a play-based approach (P-school). The participating students (20 from the T-school and 22 from the P-school) were randomly selected from grades 1-4 and had an average age of 5. This 4-week research project used a pre-post-test quasi-experimental design. Children's vocabulary development in the two educational settings was evaluated by mastery (active and passive) and semantic network of new words. Each child was scored in the pretest and post-test regarding their knowledge of different target words, and the number of theme-related words that they linked to those target words served as the indicator of the scope of the semantic network. According to the research findings, students in the P-school significantly outperformed students in the T-school in the post-test regarding both active and passive vocabulary mastery. They learned much more words during the research project. For the development of semantic networks, students in the play-based classrooms had a much larger mean semantic extent (2.082) than their peers in the task-based classrooms (0.629). They used their newly acquired theme-related words more frequently (see Table 2). Their acquired words were semantically richer and situated in a broader semantic network. The evidence from the two Dutch primary schools suggested that a play-based approach was more effectively helpful for vocabulary acquisition and development than a teacher-driven approach.

Table 2. Use of theme-related words [source: redrawn from Duijker (2003)].

Type of education	Number of theme-related words	Mean number of theme-related word per child	Number of children not using any theme-related words
T-school (20 children)	13	0.65	12
P-school (22 children)	147	6.68	1

The beneficial effect of the play-based intervention on language development is not limited to vocabulary. Fekonja *et al.* (2005) noted that preschool children produced more sophisticated grammatical speech in a play environment than in regular guided activities. In addition, evidences also show that a play-based approach facilitates narrative competencies. Ilgaz and Aksu-Koç (2005) showed that 4-year-old children demonstrated an earlier development of narrative skills when narratives were stimulated in play contexts rather than directly elicited in non-play situations. Baumer *et al.* (2005) reported that children aged 5 to 7 in a play-based setting attained significantly improved narrative abilities than their aged-matched peers in the control group without any intervention.

A more recent study by Stagnitti *et al.* (2016) in the Australian primary school context provided more holistic evidence of the positive influences of PBL on early language development. This two-year longitudinal study with a quasi-experimental design investigated the role of play-based interventions in developing young children's oral language capabilities. The participating children with an average age of five were 54 students in their first year of formal education. There were 34 children from schools following a play-based pedagogical approach (the experimental group) and 20 children from schools with regular mainstream educational practices (the control group). All children were measured for narrative language skills at school entry (Time 1) and the end of the project (Time 2). The research outcome showed that a play-based curriculum significantly improved young children's oral language skills compared with the traditional curriculum. Researchers conducted an additional assessment of a subset group of participants (28 children) to examine their lexical and grammatical knowledge. The results suggested that PBL also led to substantial gains in the acquisition of vocabulary and grammar. Researchers predicted that the positive effects of play-based pedagogical

approaches on narrative skills interlock with that on vocabulary and grammar knowledge. The study concluded that PBL was beneficial for young children's language development in terms of narrative ability and the acquisition of vocabulary and grammar (see Table 3 for an overview of research data).

Table 3. Time 1 and 2 means and learning gains of narrative, vocabulary and grammar for each curriculum type [source: redrawn from Stagnitti *et al.* (2016)].

	Curriculum	Time 1	Time 2	Learning gains
Narrative	Play-based	7.85	12.18	4.33
	Mainstream	9.35	10.35	1
Vocabulary ¹	Play-based	58.31	67.31	9
	Mainstream	64.25	72.17	7.92
Grammar ¹	Play-based	5.69	9.81	4.12
	Mainstream	9.08	11.92	2.84

¹Results for 28 children (the sub-sample).

Here, evidences from studies on vocabulary, narrative and grammar show that PBL help enhances the linguistic capabilities of young children and offers a positive endorsement for PBL in early language development.

4. PBL helps enhance children's social skills

Play-based contexts enable children to exercise, modify and develop their social behaviours. Through play-based activities, children can experience, examine and learn about various and complex modes of social interactions. Studies from different contexts show that PBL helps improve the social skills of young children.

Reynolds (2011) set up a comparison study to examine the social skills of six-year-old children from two different primary schools in lower socio-economic areas in Australia. The two schools used different pedagogical approaches, one with a play-based curriculum and the other with a traditional classroom. This quasi-experimental study used pretest and post-test for data collection. Thirty-one children completed the baseline evaluation, and five of them withdrew from the follow-up assessment held six months later due to families moving. The obtained research data (see Table 4) revealed that children taught in the play-based curriculum had considerably enhanced social interaction skills and became less disruptive and more socially connected with their peers than those in the conventional school. They were more socially engaged with their peers and less likely to be unhappy or need instructions from teachers, suggesting that PBL had a positive impact on young children's social skills. Another study with a bigger sample size conducted by Tahmores (2011) in the Teheran came to the same conclusion. The study investigated the effect of play on the development of social skills of children from kindergarten, pre-school and primary school. A total of 720 children were selected from five districts of Teheran through stratified random sampling. The final research outcome indicated that PBL facilitated the social development of young children.

Table 4. Children's baseline and follow-up raw scores and their changes in the play-based curriculum (School 1) and traditional classroom (School 2) [source: redrawn from Reynolds *et al.* (2011)].

Assessment item	Curriculum	Baseline mean	Follow-up mean	Change ¹
Social interaction	Play-based	20.55	24.28	+3.73
	Traditional	17.36	19.63	+2.27
Social disruption	Play-based	29.2	25	-4.2
	Traditional	26.27	25.88	-0.39
Social disconnection	Play-based	18.2	16.11	-2.09
	Traditional	18.36	19.75	+1.39

¹Follow-up mean minus baseline mean.

In addition to research in the general educational setting, studies in the special education context also provide valuable evidence of the benefits of PBL in improving children's social skills. The paper presents an empirical study in 2011 and a literature review study in 2021. O'Connor and Stagnitti (2011) conducted a six-month study in a specialist school in Australia to examine the social skills of five-to-eight-year-old children in a play intervention compared to their peers in a traditionally structured classroom. The intervention group involved 19 children, and the comparison group had 16 children. All participating children had an intellectual disability to some extent. Most of them had more than one diagnosis, and many had problematic behaviours and poor social interaction skills. This quasi-experimental study collected data through pretest and post-test, with baseline play assessment at the start of the research project and follow up re-evaluation six months later. The results (see Table 5) showed that children in the play intervention had significantly improved social interaction skills, were less socially disruptive and less alienated from their peers. The research findings supported the effective use of play intervention in enhancing children's social skills in a specialist school context. The systematic review by O'Keeffe and McNally (2021) examined existing practice-based research investigating the potential benefits of play-based interventions in improving social communication outcomes of children with autism spectrum disorder (ASD) within the educational landscape. The review identified twenty-nine full-text studies involving children with ASD aged three to thirteen and concluded that they offered a promising evidence base for underpinning the use of play in promoting the social communication skills of children with ASD in a special education context.

Table 5. Baseline and follow up statistics of children in the play intervention group and comparison group and their changes [source: redrawn from O'Connor and Stagnitti (2011)].

Assessment item	Curriculum	Baseline mean	Follow-up mean	Change ¹
Social interaction	Intervention group	14.84	18.47	+3.63
	Comparison group	18	18.25	+0.25
Social disruption	Intervention group	37.47	31.00	-6.47
	Comparison group	27.75	28.88	+1.13
Social disconnection	Intervention group	33.58	27.53	-6.05
	Comparison group	23.44	23.81	-0.37

¹Follow-up mean minus baseline mean.

5. Discussion and conclusions

The essay argues the benefits of PBL in the EYE context in terms of the development of mathematics competencies, linguistic capabilities and social skills. Evidence from different research methods (such as systematic review and empirical studies), various educational contexts (including preschool and early formal education as well as mainstream education and special education), and distinct countries

with different socioeconomic statuses enrich the body of evidence regarding the positive effects of PBL in young children's learning and development. Though all studies have certain limitations and are confined to specific contexts which may not be transferrable, the commonalities drawn from the conclusions of extensive studies reviewed in this paper contribute to the consistency, credibility and persuasiveness of findings. Underpinned by diverse evidence, the paper concluded that PBL is beneficial for the learning and development of young children in an EYE context. The conclusion drawn from this paper helps resolve debates surrounding the use of a play-based pedagogy in EYE and addresses the dilemma of pursuing better academic attainment and adopting play into EYE practices. The studies presented in and the conclusion of this paper have significant implications for the educational practices that adopt a play-based pedagogical approach and offer valuable references for future research regarding the role of play in early years learning and development. The positive impact of PBL on children's mathematics learning, language development and social skills informs policy agendas in the EYE context to locate the value and importance of play in EYE and promote the application of a play-based curriculum in EYE.

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Benefits of Gamification in Agile Software Project Courses

Nina Dzamashvili Fogelström
nina.dzamashvili.fogelstrom@bth.se

Abstract—This paper examines concepts of Game-Based Learning and Gamification. Conducted literature survey found an increased interest in the academia in these concepts, limited evidence of a positive effect on student motivation and academic performance, but also certain scepticism for adding games to traditional educational activities. A small-scale empirical study presented in this paper aims to evaluate student experience and usefulness of GameBased Learning and Gamification for a better understanding of the threshold concepts in software engineering project courses. The participants of the study were 22 second year students from bachelor's program in software engineering at Blekinge Institute of Technology. As a part of the course instruction, the students were introduced to a digital game specifically designed to simulate agile software project. The game mechanics were designed as to allow manipulation of the agile concept of team velocity. After the application of the game, the students were surveyed to measure the degree of a perceived increase in understanding of the studied threshold concept. The students were also asked whether they would like to have games included in their education. The results show that majority of the students found the game helpful in increasing their understanding of the threshold concept. Most of the students have indicated that they would like to see games included in their education. These results are encouraging. Since the study was of small scale and based on convenience sampling, more studies in the area are recommended.

Keywords—agile development, gamification, game based learning, digital games, software engineering, threshold concepts

I. INTRODUCTION

GAMIFICATION has become quite a buzz word in the present years. According to a systematic literature review on gamification research, Google trends report shows steady increase from year 2010 [1].

Gamifying means applying elements of games, usually designed for entertainment purposes, to essential non-game contexts [2]. Corporate world has largely embraced the idea of gamification and now there exist several tools and businesses delivering gamification solutions and experiences to different businesses. Examples of these are: Centrical[22] and Gamify [23], each providing gamification solutions for corporate training and employee engagement.

In academia, there has been a certain increase of interest in Gamification as well. A systematic review of gamification research, published in 2018, shows a steady increase of published articles starting from a few publications in year 2011 to 72 in year 2016 [1]. Somewhat earlier literature review studies, investigating Gamification in engineering

education has found a steady increase of the publications during the same time-period, showing a clear interest in the topic [3] [4].

However, when it comes to adoption of gamification in academic educational contexts there seems to be a certain scepticism among the teachers and academics [5]. This despite the positive effects on student motivation and engagement reported by several studies. Another study reports on complexity of the process of designing game elements, that seems to be crucial for achieving positive results in learning and motivation [6]. A considerable effort needs to be invested in designing game elements and this could also be potentially a reasoning for relatively low degree of adoption in academic courses.

This paper investigates potential benefits of using Gamification in Software Engineering (SE) courses, and for the purpose of aiding and enhancing the understanding of threshold concepts taught in these courses. This is accomplished by evaluating students' attitudes towards adding an online game to the typical teaching activities. The game simulates typical software development environment and game mechanics focus on enhancing understanding of software project management concepts, specifically concepts related to software project management method called SCRUM [7].

The research questions asked in this paper are:

RQ1: How do the students experience including games in education?

RQ2: To what degree does application of the game aid students in increasing their perceived understanding of the studied threshold concepts?

The remainder of the paper is organized as follows: in the Background the reader will find a short introduction to SCRUM method, positioning of related terms of Gamification and Game-based learning, followed by an overview of related work. Section on Study design and Execution will explain how the study was planned and conducted. Game elements used in the study will also be outlined here. Later, the reader will find a presentation of study results, analysis of the results and a conclusion.

II. BACKGROUND

Software Engineering (SE) is a discipline within computer sciencefield, concerned with methods and models for organizing the process of designing and building of software products that are of high quality and within the boundaries of development cost and time limitations [8]. Thus, efficient

software teams, software project management and control, process improvement and quality assurance are concerns for Software Engineers.

A. SCRUM software development model

Since the creation of the field, SE researchers together with the practitioners have invented, evaluated, and practiced several methods and models of software development, typically involving the following stages of projects: Project inception, Feasibility studies, Software requirements analysis, Cost estimation, Software design, Software development (writing of source code), Software Testing, Delivery and Software maintenance. SCRUM software development model [7] is currently dominating model for arranging software project phases and conducting standard development activities. It involves developing software in shorter iterations, called Sprints. Sprints allow for faster feedback loops and to a larger degree self – organizing software development team.

B. Team Velocity

One of the main concerns of SCRUM model, as any software project management model, is to keep track of team's progress and achieved results. Software teams applying this model must be proficient in applying specific SCRUM concepts such as creating and managing software product backlog, estimating development effort, and keeping track of team's progress and performance [9]. One of the concepts for aiding in tracking teams' performance introduced in SCRUM is the concept of Team Velocity, which is a measure of team's rate of progress per project iteration, that is per each sprint. Understanding and correct usage of this measure is useful for better estimations and planning of agile projects [10].

C. Threshold concepts in teaching

In academic teaching, threshold concepts are referred to the concepts that are challenging to grasp and at the same time are essential for understanding of the studied topic [11]. Identifying these concepts in teaching situation and addressing and finding pedagogical approaches to aid students in their efforts to understand these concepts is essential for better academic performance and deeper understanding of subject matter [12]. Thus, teachers shall be encouraged to put effort in finding pedagogical approaches for that can be helpful for understanding of these concepts.

D. Gamification and Game Based Learning

The concepts of Game Based Learning (GBL) and Gamification are both popular and often interchangeably used in the literature[1]. There is a subtle difference between the two though.

Game Based Learning is usage of games for educational purposes [13]. GBL is normally defined as purposeful usage of educational games, a pedagogical approach, where an appropriate set of game mechanics and game rules create an attractive and problem-oriented learning environment. Papers concerned with GBL often imply actual usage of an educational game, where digital or otherwise physical games are played by the students as part of their education [14]. In

later years digital games becoming more attractive as technological innovations in smart devices, web technologies and different phone and tablet applications have resulted in boom in digital games [15].

When reporting on research in Gamification, the authors sometimes imply the usage of actual games, and other times not [2]. Gamification in its definition does not imply usage of actual games and game playing. In its broader form, Gamification focuses on applying game elements (such as score-cards, levels, badges etc) to essentially non-game contexts, for increase of participation and intrinsic motivation of students and/or practitioners[4].

Depending on the level and complexity of the game design elements applied, Gamification can be more simple usage of game elements where some of the game concepts are attached to non-game contexts (using badges and points in health applications¹, using competitive game elements, levels, and points to encourage certain behaviour in employees, or staff training and education²), or it can also imply game playing and using of games in essentially non-game contents. When the later definition of Gamification is applied in educational context and level of game mechanics applied are comprehensive and involve actual gameplay, Gamification becomes almost identical to Game Based Education (GBL) [2]. This similarity must be the reason for why in the literature many authors often unconsciously confuse or consciously use the terms interchangeably in educational setting. This can easily create confusion though, as not all papers on Gamification imply actual usage of games and gameplay but rather focus on using certain game elements such as points [16].

In this paper when we mention application of a game in educational context, we mean not simply adding game elements in educational setting but using a game serious game (educational game) and gameplay for educational purposes.

III. RELATED WORK

In this section the reader will find a short overview of the related research meaning research concerning applying gamification principles in SE education.

We start out by presenting a framework for gamification in SE, put forward by [15]. The authors of the suggested framework define gamification as a practice of taking the attractive, even addictive features of "real games" (that is games designed for purely entertainment to be contrasted with the term "serious games" that is used in other sources) and inserts them into a non-game setting, such as a workplace, education, or other. Prior to writing this article, the authors have done a systematic literature review of gamification in SE area. They found 29 primary studies, first dating year 2010, indicating that research evidence in this area is rather young. They also have found that more than half of the studies were of positioning or philosophical character and

¹<https://www.apple.com/se/watchos/watchos-8/>

²www.unboxedtechnology.com/blog/gamification-techniques-for-corporate-training/

that the few studies with empirical focus were lacking rigour and sound methodological support both to evaluate the results and making it difficult to replicate the studies. They also note that existing studies are somewhat superficial, applying rather basic gamification elements randomly.

Recent studies in SE context, [17] and [18] are quite close to the educational context of the courses used in empirical study of this paper show the same pattern: They casually apply some elements of the game in SE courses and report positive results, in terms of student motivation and achieved academic result. Unfortunately, they do not show enough detail on applied game elements, or explanation on design of game elements. Further, in papers the terms of game-based design and gamification are used interchangeably, creating uncertainty with regards to rigour of applying design and decisions on including certain game mechanics and excluding others.

So, the need for rigorous approach for gamification in SE is identified, allowing to incorporate more sophisticated palette of game design including advanced game mechanics, game roles, game economics, aesthetics, and game rules. By doing so they are moving closer to richer game elements in real games (employed in game-based learning) and farther away from barely applying most basic elements such as point based elements and badges - how gamification can be understood in its most simple form [19].

Recent paper from 2022 [20], reporting on effects of using Game based learning to improve academic performance and motivation in Engineering studies, report on using game mechanics deployed in online web tool. Unfortunately, they do not explain the design and elements of the applied game mechanics or how the elements were selected (a feature that is quite common, people just tell that they have applied the game and or game elements). For this reason, it is hard to know if they have been using gamification or game-based learning in its strict sense. In any case, they report significant increase in performance and motivation for the group that was using game-based approach. They also stress that despite evidence of substantial benefit, it is still a problem with implementing game-based learning broadly in engineering education because of complexity associated with game design and effort and investment needed to implement and develop digital games. Similarly, a paper from 2015 by Meaghan C. Lister investigating the effect on student motivation and performance when using Gamification (elements of games) finds need for careful design of the game elements and game mechanics. While incorporating of games in education on general has positive results on motivation there also are some concerns: for example, too simplistic elements, like using only badges or focusing too heavily on competitiveness may have discouraging effect.

To summarize, the study of related literature uncovers studies showing positive results when including games in educational setting. However, the reported studies often lack information in how the games were designed, and terms gamification and game-based learning are not clearly defined, and scientific evidence of the studies show that there is need

for more investigation in this promising area, calling for more research.

The empirical study reported in this paper aims to provide contribution towards filling this gap by investigating potential benefits of using games in software engineering education. One of the main contributions of the study is the rigor with which the game design rules were selected and a comprehensive account of game design elements and how they were applied in educational context.

IV. STUDY DESIGN AND EXECUTION

Empirical study in this paper is a small-scale filed experiment[21]. Field experiment is suitable to use when entering pre-existing setting (such as classroom in our example) and exercising manipulation of aspects of the setting to investigate or evaluate a technique (such as introduction of a game in a traditional classroom environment). The goal was to investigate potential gains of introducing game-based learning on student motivation and understanding of taught concepts in agile project courses at Blekinge Institute of Technology, BTH.

The subjects were students participating in the software project courses. The selected threshold concept was concept of Team Velocity, introduced in background section. This concept was selected based on the experience collected from analysis of previous occasions of this course: the teachers have noticed that when explaining Team Velocity by using conventional teaching methods, using slides, and drawing on whiteboard the knowledge just would not stick. The students had difficulties in understanding and applying the concept correctly. Thus, selecting this as a threshold topic to focus on made sense.

The study was conducted in April 2022. Participants were 22 second year bachelor level students in software engineering and web programming programs. The students participate in the software project course where they in teams of 4-5 persons use software engineering practices to develop a working software product according to the specification from the project customer.

The study was executed as planned and followed three steps: 1) Use of traditional instruction material to introduce the concept; 2) Students playing a digital game and finally, 3) students were surveyed to capture perceived increase in understanding and general experience with including game in traditional teaching setting.

A. Step 1: Traditional teaching materials

The students were introduced to the agile concept of Team Velocity, and its usage for tracking team progress and performance. This was done using the traditional teaching approach by teacher introducing the concepts with the help of PowerPoint slides and whiteboard. It must be noted that before introducing the concepts the students were surveyed informally by the teacher to see if the students were familiar with the concepts from their previous experience by asking the students to raise hands if they were already familiar with the concepts to be introduced. Only few hands went up to indicate

that they recognized the concepts from their textual description.

Directly after traditional introduction of the concept, the students were asked to play a digital game which was specially designed to enhance understanding of the presented concepts. This constituted Step 2 of the study.

B. Step 2: Application of the Digital Agile Game

In this study, the traditional teaching materials were amended with gameplay. The game itself is an online game easily accessed via the web browser. The concept and source code of the game is developed and owned by Softhouse AB[24]. We were granted a permission to use it in the course.

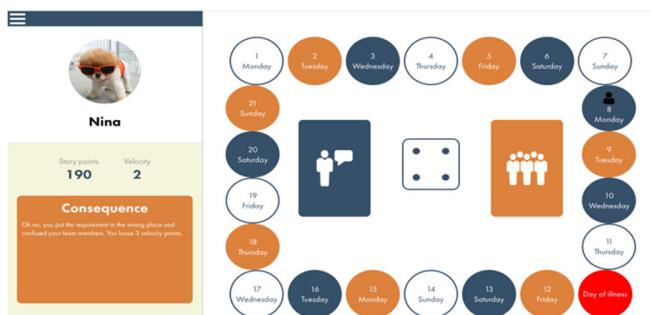


Figure 1: Screenshot showing the game elements and aesthetics

The game is simulating a typical SCRUM development scenario as an online digital board game (see Figure 1). By playing the game, the students directly operate on and use the concept of Team Velocity to take active decisions in situations prompted by the game motor, operating on specifically designed game rules (these rules are presented shortly in following paragraphs).

The reader shall be reminded that when testing effects of gameplay in educational context, we are not simply adding game elements in educational setting. Instead, we are using an actual game (educational game/serious game) that is developed specifically for educational purposes. This brings the application of the game in this study closer to the application on Game-Based Learning. For mode in depth discussion on similarities and differences between Game based Learning and Gamification please refer to the background session.

Once the students open the game, they are greeted with a welcome and a short presentation of the game rules. The game resembles a board game where the player moves from one circle to another after throwing a dice and getting a random number between 1 and 6. One means one step, number six, accordingly six steps. The circles represented in the game simulate 3 weeks of work iteration in an agile project where first circle is a day 1 and last circle is day 21, representing end of sprint iteration is SCRUM method. The challenge in the game is to maintain high development speed (Team Velocity).

A player starts out with the same amount of work to do – demoted by the total amount of remaining work to do demoted by scrum term Story Points. In the example showed in Figure 2, the player has 190 remaining story points to implement. As

the player moves along the board, depending on the circle colour, the player is exposed to different challenges that enable the player to decrease the sum of the story points with different amount. Challenges are designed to represent typical challenges of and decisions that must be made during software projects. The player that manages to decrease story points to zero in the least amount of sprint iterations wins the game.

The students were organized in pairs of two and received an instruction to play a game until they have reached the goal or until playing time was finished. The teams who could reach the goal faster won and received higher points.

The gaming session was between 20 - 25 min. The teacher was present and observing the students during the game session and could see that the students were engaged and seemingly enjoying the game. The situations occurring the game prompted discussions between the pairs and prompted students to actively use the introduced threshold concepts to make decisions in the game. Each decision resulted in coming closer to the goal or loosing points thus longer distance to the goal.

C. Step 3: The survey, evaluating student's experience

In the final step, which was initiated directly after the students were finished with the gameplay, the students answer a questionnaire and report on: a) To what degree the game had enhanced their understanding of the selected concepts. b) How they experienced using gamification in education. The students filled in the survey where they have evaluated how game had affected their understanding of the introduced SCRUM concepts and their experience with the game. The questions were of the type of Likert scale, using 5 levels. The students rated their experience across the following questions:

- Q1: How fun was the game? (1= Not fun, 5= Great fun)
- Q2: How much did the game help increase your understanding of Team Velocity? (1= Not at all, 5= Very much)
- Q3: Would you like more games in education? Yes/No.

V.RESULTS

In this section the study results are presented, and the results are analysed to arrive to the answers to the initial questions posed by the study. In total, 22 students have

Survey question	Response Category	Frequency
Q1: How fun was the game?	Not at all (1)	1
	Somewhat (2-3)	7
	Considerably (4-5)	14
Q2: How much did the game help increase your understanding of team velocity?	Not at all (1)	3
	Somewhat (2-3)	15
	Considerably (4-5)	4
Q3: Would you like more games in education?	Yes	19
	No	3

responded to the survey. The results are presented below:

Figure 2: Summary of the student responses.

Most of the students indicate good experience with the

game, finding it fun. Further, a clear majority of the students would like to see games incorporated in the education.

When it comes to the second question, Q2, most of the students indicated that the game helped in understanding the threshold concept of velocity, 15 out of 22 students indicating a moderate step in perceived increase in knowledge and four students felt that the game has helped considerably to increase their understanding of the studies concept.

RQ1: How do the students experience including games in education?

The answer to this research question is drawn from Q1 and Q3 of the conducted survey. When answering Q1 most of the students found it enjoyable to play the game, most frequent answers being 4 and 5 where 5 was equal to "Great Fun". 19 out of 22 students have answered that they would like the usage of games in education. This goes in line with the results of other studies, where several studies report on increase in student engagement and increased motivation among the students [4][18][17].

Interesting result of the study was that students recommending future use of the games in the education have also left voluntary comments, explaining that high score in the answer only applied in the case where the game was sophisticated, well designed and represented the studied context well. This relates well with the conclusions presented in [6], where the importance of careful design of the game elements and game mechanics is emphasised.

While incorporating of games in education on general has positive results on motivation there also are some concerns: for example, too simplistic elements, like using only badges or focusing too heavily on competitiveness may have discouraging effect[16]. Thus, it seems that more deeper understanding of game design and careful selection of which elements of games shall be incorporated in specific educational contexts is essential.

RQ2: To what degree does application of the game aid students in increasing their perceived understanding of the studied threshold concepts?

To answer this question result of Q2 from the conducted survey was unitized. The results show that a clear majority of the students experienced an increase of the understanding, results showing that three out of 22 students have indicated no change in understanding after the game. The commonly assigned point to the increased knowledge was 2 and 3 (15 out of 22), indicating a moderate step in perceived increase in knowledge.

It can be concluded that the students perceived that the process of playing game even it was quite brief, have helped them to understand the studies threshold concept of team velocity better. Here it is important to note that because the students have been asked to answer the question on knowledge increase quite direct after playing the game, their answers are purely perceptive. So, what can be concluded here is that the results are encouraging but cannot be entirely conclusive. This result resonates well with other studies attempting to measure the impact of Gamification and GBL on student learning and

academic performance, many finding conflicting results and difficulties to measure the increase in knowledge conclusively [14] [16] [6].

For the future studies more objective test of the knowledge increase would be desirable. On the other hand, since majority of the students indicate the increase of knowledge after only playing the game for on average 15 min, it seems to be a good investment of time and interesting to see how the game mechanics and way it was applied can be perfected to achieve potentially larger increase in understanding.

VI. CONCLUSIONS

This paper investigates potential benefits of using and Gamification in Software Engineering (SE) courses, and for the purpose of aiding and enhancing the understanding of threshold concepts taught in these courses. This is accomplished by evaluating students' attitudes towards adding an online game to the typical teaching activities. The game simulates typical software development environment and game mechanics focus on enhancing understanding of software project management concepts, specifically concepts related to software project management method, SCRUM.

The results of the conducted empirical study indicate that incorporating games in SE education can be beneficial for students learning and motivation.

Further, both survey of related literature and results of the conducted study indicate that even though there is a potential for increased motivation, participation and increased academic performance when adding games into educational context, measuring these effects are challenging. It is essential to take extreme care when selecting game elements, understanding of game design. For this reason, time and effort must be devoted to careful selection of which elements of games shall be incorporated in specific educational contexts.

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The Decision-Making Process of the Central Banks of Brazil and India in Regional Integration: A Comparative Analysis of MERCOSUR and SAARC (2003-2014)

Andre Sanches Siqueira Campos

Abstract— Central banks can play a significant role in promoting regional economic and monetary integration by strengthening the payment and settlement systems. However, close coordination and cooperation require facilitating the implementation of reforms at domestic and cross-border levels in order to benchmark with international standards and commitments to the liberal order. This situation reflects the normative power of the regulatory globalization dimension of strong states, which may drive or constrain regional integration. In the MERCOSUR and SAARC regions, central banks have set financial initiatives that could facilitate South America and South Asia regions to move towards convergence integration and facilitate trade and investments connectivities. This is qualitative method research based on a combination of the Process-Tracing method with Qualitative Comparative Analysis (QCA). This research approaches multiple forms of data based on central banks, regional organisations, national governments, and financial institutions supported by existing literature. The aim of this research is to analyze the decision-making process of the Central Bank of Brazil (BCB) and the Reserve Bank of India (RBI) towards regional financial cooperation by identifying connectivity instruments that foster, gridlock, or redefine cooperation. The BCB and The RBI manage the monetary policy of the largest economies of those regions, which makes regional cooperation a relevant framework to understand how they provide an effective institutional arrangement for regional organisations to achieve some of their key policies and economic objectives. The preliminary conclusion is that both BCB and RBI demonstrate a reluctance to deepen regional cooperation because of the existing economic, political, and institutional asymmetries. Deepening regional cooperation is constrained by the interests of central banks in protecting their economies from risks of instability due to different degrees of development between countries in their regions and international financial crises that have impacted the international system in the 21st century. Reluctant regional integration also provides autonomy for national development and political ground for the contestation of Global Financial Governance by Brazil and India.

Keywords— Brazil, central banks, decision-making process, global financial governance, India, MERCOSUR, connectivity, payment system, regional cooperation, SAARC.

Andre Sanches Siqueira Campos is with the in KU Leuven, Belgium (e-mail: andresanches41@gmail.com).

Assessing the Effectiveness of a Field Project Program Course

Shubhra P. Gaur, Perpetua Fernandes

Abstract— On one hand, the business world is ever-changing and dynamic and on the other, the recruiters are expecting industry-ready problem solvers in their management trainees more than ever before. Against this backdrop, there is a need to curate innovative, cohesive, and transformational programs. It is imperative to explore and include collaborative, field-based learning that in turn would lead to a creative and generative approach to real-world problem-solving. Partnering in teams helps students in team-building and accepting diversity across professions towards achieving success. The objective of this research is to assess the effectiveness of a newly launched field project program (FPP) course on the problem-solving skills of the students in a leading management school.

The FPP course aims to develop problem-solving skills in the students for solving real-world problems by demonstrating measurable impact on the client organization. This is achieved by getting students to partner with organizations and immersing them in a field project. The course design is unique in nature; it is interactive, inclusive, and provides experiential learning. Client Organization shares a problem with a team of students as a self-learning opportunity for collaborative work. Each student team is given considerable autonomy to understand the client's problem and implement a 'measurable impact' solution.

The objective of this research is to illustrate that the students who successfully complete an optional Field Project Programme (FPP) will have higher scores on problem-solving than those who do not.

We have used a field experimental research design to study the effectiveness of the experience and learning of the FPP on problem-solving skills. The Independent variable is FPP experience, and the dependent variable is a problem-solving skill.

A specially designed learning assessment test was used to measure problem-solving skills.

In a management school, students are also involved in committees such as Alumni Activities, Management festival, Placements, TEDx, and the like, to provide them with real-world experience. To study the effectiveness of the learnings through FPP, it was found essential to eliminate the impact of learnings from involvement in committees, and hence following four groups have been chosen to illustrate the effectiveness of learnings through the FPP:

Group 1 comprises 35 students who have opted only for FPP

Group 2 comprises 40 students who are involved in student committees

Group 3 includes 26 students who have neither opted for FPP nor any student committee

Group 4 contains 79 students who have opted for FPP and have also been involved in student committees.

The data analysis was done using SPSS. ANOVA was used to test the following hypotheses:

H1: Group 1 will have higher scores on the problem-solving test as compared to Groups 2 and 3.

H2: Group 3 will have the lowest scores on the problem-solving test as compared to all the other groups.

H3: Group 4 will have the highest scores on the problem-solving test as compared to all the other groups.

The results have been discussed in the light of learning theory of Kolb.

Shubhra P. Gaur is with the in MICA, India (e-mail: shubhra.gaur@micamail.in).

Keywords— field based learning, experiential learning, collaborative learning, problem solving.

Impact of Job Crafting on Work Engagement and Well-being among Indian Working Professionals

Arjita Jhingran

Abstract

The pandemic was a turning point for flexible employment. In today's market, employees prefer companies that provide the autonomy to change their work environment and are flexible. Post pandemic employees have become accustomed to modifying, re-designing, and re-aligning their work environment, task, and the way they interact with co-workers based on their preferences after working from home for a long time. In this scenario, the concept of job crafting has come to the forefront, and research on the subject has expanded, particularly during COVID-19. Managers who provide opportunities to craft the job are driving enhanced engagement and well-being. The current study will aim to examine the impact of job crafting on work engagement and psychological well-being among 385 working professionals, ranging in the age group of 21- 39 years. ($M_{age}=30$ years). The study will also draw comparisons between freelancers and full-time employees, as freelancers have been considered to have more autonomy over their job. A comparison-based among MNC or startups will be studied; as for the majority of startups, autonomy is a primary motivator. Moreover, a difference based on the level of experience will also be observed, which will add to the body of knowledge. The data will be collected through Job Crafting Questionnaire Utrecht Work Engagement Scale and Psychological Well-Being Scale. To infer the findings, correlation analysis will be used to study the relationship among variables, and a Three way ANOVA will be used to draw comparisons.

Keywords: *Job Crafting, Work Engagement, Well-Being, Freelancers, Start Ups.*

Author Details

Name: Arjita Jhingran

Email ID: arjita.jhingran@gmail.com

Institute: Christ University, Bangalore India

Phone No: 8826669047

The Negative Impact of The SARS-CoV-2 Pandemic on Maternal and Child Health, Considering Maternal Experiences of Abuse and Neglect in Childhood

Franziska Köhler-Dauner¹, Inka Mayer¹, Lara Hart¹, Ute Ziegenhain¹, Jörg M. Fegert¹

¹ Dept. of Child and Adolescent Psychiatry/Psychotherapy, University Hospital of Ulm,
Steinhövelstraße 5, 89075 Ulm, Germany

Abstract— Preventive isolation and social distancing strategies during the SARS-CoV-2 pandemic have confronted families with a variety of different restrictions and stresses. Especially during this stressful time, children need a stable parental home to avoid developmental disorders. Additional risk factors such as maternal childhood abuse and neglect (CM) experiences may influence mothers' psychosomatic health (pG) and children's physical well-being (kW) during times of increased stress.

Our aim was to analyse the interaction between maternal CM, maternal pG and children's kW during the pandemic.

Mothers from a well-documented birth cohort to study transgenerational transmission of CM, were included in an online 'pandemic' survey assessing maternal pG and children's physical health during the pandemic.

Our mediation analysis showed a significant positive association between the extent of maternal CM experiences, mothers' psychosomatic symptoms and their children's kW. Maternal psychosomatic symptoms significantly mediate the interaction between CM and children's kW; the direct effect remains non-significant when maternal psychosomatic symptoms are included as mediators.

Maternal CM appears to be a relevant risk factor for maternal pG and children's kW during the pandemic. Maternal CM experiences seem to influence the way parents cope with stressful situations and increase the risk of suffering from depressive symptoms. The latter also affect their children's kW. Our findings underline the importance of carefully assessing the specific situation of families with children and offering individually adapted help to help families survive the pandemic.

Keywords— pandemic, maternal health, child health, abuse, neglect, maternal experiences.

Destination Management Organization in the Digital era: A Data Framework to Leverage Collective Intelligence

Alfredo Fortunato, Carmelofrancesco Origlia, Sara Laurita, Rossella Nicoletti

Abstract—In the post-pandemic recovery phase of tourism, the role of a Destination Management Organization (DMO) as a coordinated management system of all the elements that make up a destination (attractions, access, marketing, human resources, brand, pricing, etc.) is also becoming relevant for local territories. The objective of a DMO is to maximize the visitor's perception of value and quality while ensuring the competitiveness and sustainability of the destination, as well as the long-term preservation of its natural and cultural assets, and to catalyze benefits for the local economy and residents. In carrying out the multiple functions to which it is called, the DMO can leverage a collective intelligence that comes from the ability to pool information, explicit and tacit knowledge and relationships of the various stakeholders: policy makers, public managers and officials, entrepreneurs in the tourism supply chain, researchers, data journalists, schools, associations and committees, citizens, etc. The DMO potentially has at its disposal large volumes of data and many of them at low cost that need to be properly processed to produce value.

Based on these assumptions, the paper presents a conceptual framework for building an information system to support the DMO in the intelligent management of a tourist destination, tested in an area of southern Italy. The approach adopted is data-informed and consists of four phases:

1. formulation of the knowledge problem (analysis of policy documents and industry reports; focus groups and co-design with stakeholders; definition of information needs and key questions);
2. research and metadatation of relevant sources (reconnaissance of official sources, administrative archives and internal DMO sources);
3. gap analysis and identification of unconventional information sources (evaluation of traditional sources with respect to level of consistency with information needs, freshness of information and granularity of data; enrichment of the information base by identifying and studying web sources such as Wikipedia, Google Trends, Booking.com, Tripadvisor, websites of accommodation facilities and online newspapers);
4. definition of the set of indicators and construction of the information base (specific definition of indicators and procedures for data acquisition, transformation and analysis).

The framework derived consists of 6 thematic areas (accommodation supply, cultural heritage, flows, value, sustainability and enabling factors), each of which is divided into 3 domains that gather a specific information need represented by a scheme of questions to be answered through the analysis of available indicators. The framework is characterized by a high degree of flexibility in the European context given that it can be customized for each destination by adapting the part related to internal sources. Application to the case study led to the creation of a decision support system that allows:

- integration of data from heterogeneous sources including through the execution of automated web crawling procedures for data ingestion of social and web information;
- reading and interpretation of data and metadata through guided navigation paths in the key of digital story-telling;

Rossella Nicoletti is with the in WISH S.r.l.s, Italy
(e-mail: rossella.nicoletti@wishinnovation.it).

Detecting Memory-related Gene Modules in sc/snRNA-seq Data by Deep-learning

Yong Chen

Abstract—To understand the detailed molecular mechanisms of memory formation in engram cells is one of the most fundamental questions in neuroscience. Recent single-cell RNA-seq (scRNA-seq) and single-nucleus RNA-seq (snRNA-seq) techniques have allowed us to explore the sparsely activated engram ensembles, enabling access to the molecular mechanisms that underlie experience-dependent memory formation and consolidation. However, the absence of specific and powerful computational methods to detect memory-related genes (modules) and their regulatory relationships in the sc/snRNA-seq datasets has strictly limited the analysis of underlying mechanisms and memory coding principles in mammalian brains. Here, we present a deep-learning method, named SCENTBOX, to detect memory-related gene modules and causal regulatory relationships among them from sc/snRNA-seq datasets. SCENTBOX first constructs codifferential expression gene network (CEGN) from case versus control sc/snRNA-seq datasets. It then detects the highly correlated modules of differential expression genes (DEGs) in CEGN. The deep network embedding and attention-based convolutional neural network strategies are employed to precisely detect regulatory relationships among DEG genes in a module. We applied them on scRNA-seq datasets of *TRAP*; *Ai14* mouse neurons with fear memory and detected not only known memory-related genes, but also the modules and potential causal regulations. Our results provided novel regulations within an interesting module including Arc, Bdnf, Creb, Dusp1, Rgs4 and Btg2. Overall, our methods provide a general computational tool for processing sc/snRNA-seq data from case versus control studie, and a systematic investigation of fear-memory-related gene modules.

Keywords— sc/snRNA-seq, Memory Formation, Deep Learning, Gene Module, Causal Inference.

Yong Chen is with the Rowan University, Glassboro, NJ 08028 USA
(phone: 856-256-4500; e-mail: chenyong@rowan.edu).

The Art of Being Healthy to Help Others to Stay Healthy

Claude Kamga Defo, Chantal Legault, Yasaman Hadian

Abstract

Learning Objectives

Learning to connect to Nature, the concept of Earth-Humans-Heaven, Universe and 5 elements.

Practitioners will learn to protect themselves from pathogenic energies and apply the principle of Qi-Thought-Needle in TCM.

General Description

Therapists should be healthy before treating patients, and stay healthy to help and heal others.

Utilizing the concepts of Earth-Humans-Heaven in the field of health enable therapists to connect to the Earth, the solar system, the Universe, the Five Elements of Nature and to transferring this energy.

Objectives

Participants will be able to meditate in order to understand and use this knowledge in their daily clinical work as well as their personal life.

The importance of listening to Nature, connect and stay connected to Nature, which helps to learn how to heal directly from Nature or take and share what we can receive from Nature. In addition, by giving and transferring the energy received from Nature to help others. To understand how Nature can help our patients to stay healthy.

We should ask ourselves, if we should avoid pathogenic energies to protect ourselves. In the case that we still receive those pathogenic energies how to clean ourselves after receiving them. Maybe it should be better to learn how to anticipate and avoid the "negative effects". The participants will learn how to take, exchange and transform positive and negative energies of the Nature.

In addition, they will understand the principle of Qi-Thought-Needle and its involvement in acupuncture treatment.

Moreover, to use the hands and Qi to heal or cure through the needle.

Methods

C. K. D. Author is a Doctor in TCM and president of Centre Énergie Santé Kamga Inc., Montreal, Canada. He obtained his Master in Acupuncture, Beijing, China. He is a Master of Taichi/Qigong. (phone: 001- 514-632-6275; e-mail: centreenergiesantekamga@gmail.com).

C. L. Co-Author, graduated in Physiotherapy in 1997, University of Montreal and graduated in Acupuncture in 2018, Rosemont College, Montreal, Canada. Taichi&Qigong instructor (phone:001-514-632-6275; e-mail: centreenergiesantekamga@gmail.com)

Y. H. Co-Author is Quality Assurance Specialist in Pharmaceutical Industry. BSc. in Chemistry, Concordia University, Montreal, Canada. Taichi&Qigong instructor assistance. (phone: 001- 514-632-6275; e-mail: centreenergiesantekamga@gmail.com)

This paper includes a theoretical presentation and a practical part. The theoretical presentation will address: How and why should we listen to Nature?

The practical part will allow participants to learn the art of breathing, the art of vital energy, the art of internal energy, how to communicate with the 5 elements such as metal (needle), water, etc. and how to use the energy around us to help patients.

Still breathing exercises, semi-stilled and dynamic exercises called Qigong / Taichi will be taught and explained by using 5 main plans:

- 1.Physical
2. Respiratory
3. Energy
4. Medical
5. Spiritual

Results

For decades, Traditional Chinese Medicine has used the art of vital energy, the Qi, to heal and stay healthy. The needle is more than a needle so by using the principle of Qi-thought-needle, we have great results.

Conclusion/Discussion

With extensive experience in East and West, it is important that TCM Doctors draw back to the main source of life. While it is helpful to work with modern technology, it is necessary to keep the essence of acupuncture tradition. Many of us forget the deep aspect of treatment in TCM, forget the goal of the treatment, forget the Nature and the omnipresence of Qi.

Keywords— Nature-Healing, Qi-Energy, Qigong-Acupuncture, Taichi.

Experiences of 529 Donor-Conceived Adults: Disclosure, Using a Donor, Donating

Wendy Kramer

Abstract— How and when a donor-conceived person (DCP) learns about their conception significantly affects their experiences and choices, including whether they'd consider using a donor or donating their own gametes.

Objective: We sought to identify factors that positively and negatively impact the experience of being a DCP. We sought to determine if DCP would consider utilizing donor gametes themselves, if unable to conceive spontaneously and if DCP were likely to be donors themselves. Materials and Methods: A cross-sectional survey of adult DCP was disseminated to members of the Donor Sibling Registry. The survey consisted of 31 items, including whether experience as DCP was positive or negative, the willingness to use donor gametes if spontaneous conception was not an option, and questions regarding donating gametes. Results: 529 people (81.7% female) completed the survey, the median age was 28 years (range 18-77 years), and 94.7% were conceived via donor sperm. Most felt "neutral" (31.6%), "positive" (26.3%) or "very positive" (20.8%) about being a DCP regardless of donor type. While most found out about being a DCP after age 18 (63.4%), those with a positive experience were more likely to "have always known" (40.7%). Conclusions: People conceived by donor-assisted reproduction are more likely to have neutral to overall positive feelings surrounding their conception if they are told at a very young age about their donor-conceived origins by a family member. The majority of DCPs are willing to adopt but would not consider using donated gametes themselves if unable to conceive spontaneously. DCPs are not likely to become donors themselves despite the majority of DCP having a high positive feeling regarding being donor-conceived.

Keywords— donor conception, sperm donation, oocyte donation, donor-conceived people, infertility.

Wendy Kramer is with the in Donor Sibling Registry, United States (e-mail: wendy@donorsiblingregistry.com).

Children Asthma; The Role of Molecular Pathways and Novel Saliva Biomarkers Assay

Seyedahmad Hosseini¹, Mohammadjavad Sotoudeheian²

1. Faculty of Medicine, Iran University of Medical Science, Tehran, Iran
2. Physiology Research Center, Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran

Abstract—

Introduction: Allergic asthma is a heterogeneous immuno-inflammatory disease based on Th-2-mediated inflammation. Histopathologic abnormalities of the airways characteristic of asthma include epithelial damage, subepithelial collagen deposition.

Objectives: Human bronchial epithelial cell genome expression of TNF- α , IL-6, ICAM-1, VCAM-1, nuclear factor (NF)- κ B signaling pathways up-regulate during inflammatory cascades. Moreover, immunofluorescence assays confirmed the nuclear translocation of NF- κ B p65 during inflammatory responses. An absolute LDH leakage assays suggested LPS-induced cells injury and the associated mechanisms are co-incident events. LPS-induced phosphorylation of ERK and JNK causes inflammation in epithelial cells through inhibition of ERK and JNK activation and NF- κ B signaling pathway. Furthermore, the inhibition of NF- κ B mRNA expression and the nuclear translocation of NF- κ B lead to anti-inflammatory events. Likewise, activation of SUMF2 which inhibits IL-13 and reduces Th2-cytokines, NF- κ B, and IgE levels to ameliorate asthma. On the other hand, TNF α -induced mucus production reduced NF- κ B activation through inhibition of activation status of Rac1 and I κ B α phosphorylation. In addition, bradykinin B2 receptor (B2R) which mediates airway remodeling regulates through NF- κ B. Bronchial B2R expression is constitutively elevated in allergic asthma. In addition, certain NF- κ B -dependent chemokines function to recruit eosinophils in the airway. Besides, bromodomain containing 4 (BRD4) plays a significant role in mediating innate immune response in human small airway epithelial cells as well as transglutaminase 2 (TG2) which is detectable with in saliva. So, the guanine nucleotide-binding regulatory protein α -subunit, G α 16, expressing a κ B-driven luciferase reporter. This response was accompanied by phosphorylation of I κ B α . Furthermore, expression of G α 16 with in saliva markedly enhanced TNF- α -induced κ B reporter activity.

Methods: The applied method to form NF- κ B activation is the electromobility shift assay (EMSA). Also, B2R-BRD4-TG2 complex detection by immunoassay method within saliva with EMSA of NF- κ B activation, may be a novel biomarker for asthma diagnosis and follow up.

Conclusion: This concept introduces NF- κ B signaling pathway as potential asthma biomarkers and promising targets for the development of new therapeutic strategies against asthma.

Keywords—NF- κ B, asthma, saliva, T-helper.

Counseling all Donor Family Members: A Guide for Mental Health Professionals

Wendy Kramer

Abstract— Donor families are unique, yet also becoming increasingly common, and the challenges of forming and redefining family as all donor family members explore their own or their child's new biological connections can seem overwhelming. It's not uncommon for these people to feel a sense of confusion or discomfort in regards to their own story or their own or their family's boundaries when it comes to utilizing a donor or donating gametes, issues surrounding disclosure, learning that they are donor-conceived, or reaching out to their own or their child's new genetic relatives. Grappling with the depth and breadth, and the timing and speed with which they explore their own or their child's origins and expanding families can be challenging, but also deeply profound and rewarding.

Keywords— Donor Families, Donor Conception, Donor Conceived, Sperm Donation, Egg Donation, Counseling.

Wendy Kramer is with the in Donor Sibling Registry, United States (e-mail: wendy@donorsiblingregistry.com).

Epicardial Fat Necrosis in a Young Female: A Case Report

Tayyibah Shah Alam, Joe Thomas, Nayantara Shenoy

Abstract— Presenting a case that we would like to share, the answer is straight forward but the path taken to get to the diagnosis is where it gets interesting. A 31-year-old lady presented to the Rheumatology Outpatient department with left-sided chest pain associated with left-sided elbow joint pain intensifying over the last 2 days. She had been having a prolonged history of chest pain with minimal intensity since 2016. The pain is intermittent in nature. Aggravated while exerting, lifting heavy weights and lying down. Relieved while sitting. Her physical examination and laboratory tests were within normal limits. An electrocardiogram (ECG) showed normal sinus rhythm and a chest X-ray with no significant abnormality was noted. The primary suspicion was recurrent costochondritis. Cardiac blood inflammatory markers and Echo were normal, ruling out ACS. CT chest and MRI Thorax contrast showed small ill-defined STIR hyperintensity with thin peripheral enhancement in the anterior mediastinum in the left side posterior to the 5th costal cartilage and anterior to the pericardium suggestive of changes in the fat-focal panniculitis. Confirming the diagnosis as Epicardial fat necrosis. She was started on Colchicine and Nonsteroidal anti-inflammatory drugs for 2-3 weeks, following which a repeat CT showed resolution of the lesion and improvement in her. It is often under-recognized or misdiagnosed. CT scan was collectively used to establish the diagnosis. Making the correct diagnosis prospectively alleviates unnecessary testing in favor of conservative management.

Keywords— EFN, panniculitis, unknown etiology, recurrent chest pain.

Tayyibah Shah Alam is with the in Aster Medcity, India (e-mail: tayyibahshahalam@gmail.com).

The Role of Txnrd2 Deficiency in Epithelial-To-Mesenchymal-Transition (EMT) and Tumor Formation in Pancreatic Cancer

Chao Wu
Technical University of Munich, Germany

Abstract:

Thioredoxin reductase 2 is a mitochondrial enzyme that belongs to the cellular defense against oxidative stress. We deleted mitochondrial Txnrd2 in a KrasG12D-driven pancreatic tumor model. Despite an initial increase in precursor lesions, tumor incidence decreased significantly. We isolated cancer cell lines from these genetically engineered mice and observed an impaired proliferation and colony formation. Reactive Oxygen Species, as determined by DCF fluorescence, were increased. We detected a higher mitochondrial copy number in Txnrd2-deficient cells (KTP). However, measurement of mitochondrial bioenergetics showed no impairment of mitochondrial function and comparable O₂-consumption and extracellular acidification rates. In addition, the mitochondrial complex composition was affected in Txnrd2 deleted cell lines. To gain better insight into the role of Txnrd2, we deleted Txnrd2 in clones from parental KrasG12D cell lines using Crispr/Cas9 technology. The deletion was confirmed by western blot and activity assay. Interestingly, and in line with previous RNA expression analysis, we saw changes in EMT markers in Txnrd2 deleted cell lines and control cell lines. This might help us explain the reduced tumor incidence in *KrasG12D; Txnrd2Δpanc* mice.

Biography

Chao Wu has completed his master at the age of 28 years from Shanghai JiaoTong University, China. He is doing his PHD study at Technical University of Munich, Germany. He focus on PDAC research.

Presenting author details

Full name: Chao Wu
Contact number: +49 017642074542
Twitter account:
Linked In account:
Session name/ number:
Category: Poster presentation



Factors Influencing Implementation of Simulation in Nursing and Midwifery Education in Malawi

Gertrude Mwalabu^{1*}, Masauko Msiska², Ingrid Tjoflåt³, Patrick Mapulanga⁴, and Annie Msosa¹

Gertrude Mwalabu is with the in Kamuzu University of Health Sciences, Malawi (e-mail: gmwalabu@kuhes.ac.mw).

Introduction Simulation-based education (SBE) is found to be useful in acquisition of nursing and midwifery skills. Yet, there is limited experience and documentation related to implementation of SBE within nursing and midwifery education in Malawi. Hence, the current study explored factors influencing implementation of SBE in nursing and midwifery training institutions and clinical sites in Malawi.

Objectives: The study aimed at identifying key gaps and factors influencing implementation of simulation-based education among nursing and midwifery lecturers and clinical instructors in the selected colleges and clinical sites in Malawi.

Methodology: This cross-sectional study utilized mixed methods to collect data through questionnaires, focus group discussions, in-depth interviews and desk review of nursing and midwifery syllabi and curricula in Malawi. Review of syllabi developed by Nurses and Midwives Council of Malawi (NMCM) as the regulatory body of nursing and midwifery education in Malawi; and institutional curricula was done to supplement data which was collected through questionnaires, focus group discussions, and in-depth interviews. Questionnaires were administered to 147 clinical instructors and lecturers/tutors working at the four central hospitals, Nkhotakota District Hospital and 146 students in five nursing and midwifery training institutions in Malawi. Ten focus group discussions were conducted with final year nursing and midwifery students. In-depth interviews were conducted with Deputy Hospital Directors (nursing and midwifery services), Principals, Deans, heads of departments, Director of Nursing and Midwifery Services (MOH) and NMCM registrar.

Results: The study revealed that despite 247(83.4%) having theoretical knowledge on the use of simulation in nursing and midwifery education, only 32 (12.9%) mentioned simulations as a current teaching method in nursing and midwifery education. Most participants felt that the current didactic teaching (traditional - teacher centred) methods do not reinforce acquisition of nursing and midwifery skills among students. The results showed a conundrum of trying to implement simulation in nursing and midwifery education without being explicitly reflected in module objectives and contents except mentioning it as a teaching method. Dearth of simulation in nursing and midwifery syllabi and curricula, lack of SBE experts, expertise, appropriate simulation infrastructure, skills laboratories and teaching hospitals and equipment were identified as key factors influencing implementation of SBE in Malawi.

Implications: The current study strongly recommends simulation as an innovative and evidence-based clinical teaching strategy in nursing and midwifery education in Malawi. NMCM syllabi, NMCM simulation guidelines and institutional nursing and midwifery curricula need to be reviewed to incorporate simulation as a ubiquitous approach for empowering nursing and midwifery students and graduates with the necessary skills, knowledge and confidence to be safe practitioners and patient safety advocates.

Keywords: simulation, fidelity, nursing education, clinical teaching.

INTRODUCTION

The use of simulation in healthcare education is increasing and the method and pedagogy is used in numerous nursing curricula (Sweeney et al. 2019; Girzelska et al. 2019; Arigbede et al. 2014; Duphily 2014; Aggarwal et al. 2010). However, there was limited experience and documentation related to simulation-based education within health education programs in low-income countries (Lewis 2016; Kaaya et al. 2012). Among others, Kim (2017) states that the use of simulation-based education was limited in low-income countries, as it demands expensive equipment, advanced facilities, and experienced staff members. Simulation-based education may however be implemented through less complex technology-based simulation scenarios in situations where high-fidelity simulation settings are not available and hence introduce simulation-based education through simple scenarios with standardized patients using low-fidelity simulation settings (Parry & Fey, 2019; Livingston et al. 2014). In a report, Tjoflåt et al. (2021) describe how simulation-based education is found to be motivating and useful for both students and teachers in a nursing program in low-income settings. This study was therefore designed to determine feasibility and identify factors that influence implementation of simulation-based education in Malawian context.

METHODOLOGY AND METHODS

This cross-sectional study utilized mixed methods. The review of curricula documents and qualitative data were used to supplement the baseline survey to provide contextual understanding of the gaps and feasibility of implementing simulation-based education in nursing and midwifery in Malawi. The study was conducted in the four central hospitals (Queen Elizabeth, Zomba, Kamuzu and Mzuzu) and Nkhota-kota District Hospital where most students are placed for clinical practice/placements and KUHeS graduates are deployed, as well as in the five nursing and midwifery training institutions. Data was collected through desk reviews, questionnaires, in-depth interviews and focus group discussions in a designated room within the institutions to ensure privacy.

For the qualitative studies, all participants were recruited through purposeful sampling. Focus group discussions were conducted with final year students and each group comprised 8 to 12 participants. In-depth interviews were conducted with key informants. Data saturation reached at ten FGDs and 35 in-depth interviews.

The statistical units of the quantitative study were the college and health facility. The target population were institutional nursing and midwifery clinical instructors and lecturers/tutors. The team used institutional staff and central/district health office statistics to draw the sample frame for lecturers/tutors and graduates/preceptors respectively. The sample size for the population was estimated at 299 for KCN nursing and midwifery graduates using Cochran's Formula. The quantitative data was collected using android application and was uploaded to the cloud on a daily basis. Recording of the interviews was done with the permission of the participants in order to ensure accuracy in the collected data. The qualitative and quantitative data were analysed using Nvivo 12 and STATA 17 respectively. For quantitative approach, descriptive analysis was done to establish indicators and strategies that would help to implement simulation-based education. Content analysis methods helped to complement, understand and triangulate information collected from the interviews and focus group discussions.

Ethical approval to conduct the study was obtained from College of Medicine Research and Ethics Committee. Permission to access participants was obtained from Central and District

Health Offices and other relevant gate keepers of the training institutions. Verbal and written informed consent was obtained from each participant before interview or engaging in discussions.

RESULTS

Focusing on various aspects that formulate knowledge base in simulation based education, the study investigated participants' knowledge on the use of simulation-based education in nursing and midwifery education. The various aspects included: (i) knowledge level on simulation, and (ii) use of simulation as per NMCM syllabi and institutional curricula documents,

Knowledge Level and Skills Gaps on simulation

While others reported that they had never heard about simulation, 12.9% mentioned simulations as a current teaching method in nursing and midwifery. Some participants indicated that simulation could promote skills acquisition among nursing and midwifery students:

"I have never heard about simulation as a student till now as a nursing administrator.to be honest with you the current teaching methods have shown a gap in skills acquisition among nursing students and we spent more time teaching students meaning they are not gaining adequate skills in training institutions.....there is need to adopt new teaching methods that facilitate skill acquisition... for the four years of my training time, I never heard about simulation" PNO Zomba Mental Hospital.

Participants felt that most current teaching methods do not reinforce acquisition of nursing skills among students:

"With simulation, learners easily understand the concept. Through only lecture method students may not understand when taught for the first time, but when a simulator is involved, students understand the procedures better and quickly. Simulation also promotes reflective practice because the student would have seen the skill in the skills lab therefore, they can easily recall and act accordingly". (N&M Education and Training Specialist, NMCM)

The study assessed participants' theoretical knowledge on use of simulation in nursing and midwifery education. The study results showed that 247(83.4%) had the knowledge on the use of simulation in nursing and midwifery education. Of these participants, 117(47.4%) were students, 112(45.3%) were bedside nurses/midwives and 18(7.3%) were nurse administrators/educators.

On the sources of information, the study participants indicated to have obtained the information/skills on the use of simulation in nursing and midwifery education from various sources. Mostly, participants indicated that college training was the main source of knowledge and skills on simulation in nursing education 221 (85.4%) and clinical setting 93 (37.7%). The other sources of such information included internet 20 (35.1%) relative to other sources), reading books/journals 5(8.8%), external experts and inservice training 11 (19.3%) at the work place and many other sources.

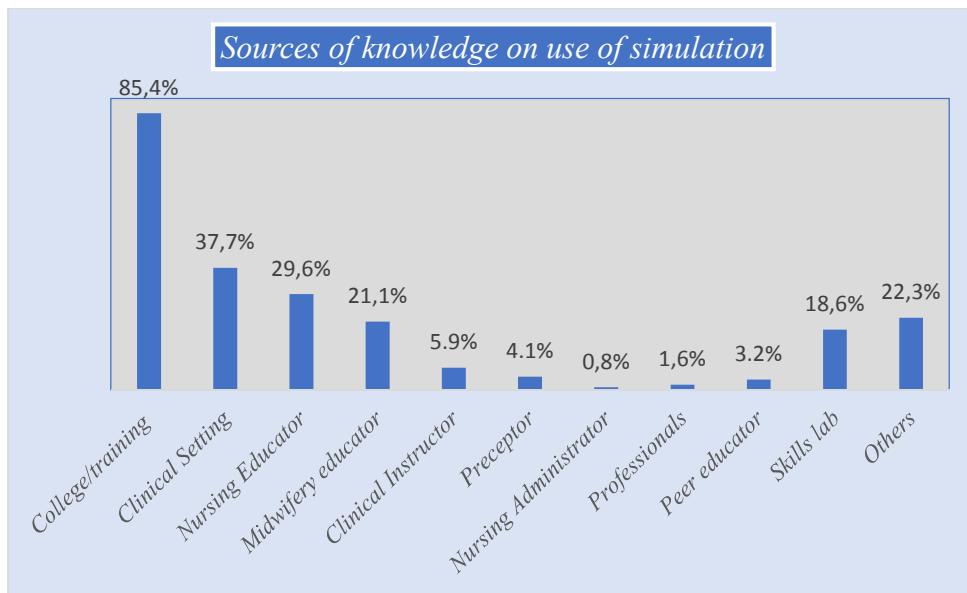


Figure 1: Sources of knowledge on information/skills on use of simulation in Nursing and Midwifery education.

Despite participants demonstrating diverse understanding of simulation basing on the perceived benefits as compared to other teaching methods, their comments seemed to overemphasize on students' opportunity of mimicking real-life situations with simulation which allows them to reflect on their performance on as exemplified in the following quotes:

"Simulations give more of a practical perspective (hands-on experience) than lecturing which provides the theory part only; and is more engaging than other methods." Nursing Officer, Kamuzu Central Hospital

"The other methods like lecturing do not contextualize the information but with simulation you bring in real life situations which helps students connect with the real environment and also allows room for reflection." Lecturer, KUHeS BT'

Qualitative data revealed that most participants gained knowledge on simulation through formal trainings (orientation on teaching methods, clinical preceptorship, on-job, postgraduate studies and refresher courses mostly abroad rather than locally); mentorships; internet (online); research and literature reviews.

".....I came across simulation-based education first during my preparation as an educator (at high-level - clinical teaching training) and also through engagements with a number of institutions including Northwest University during a tour of their clinical lab; and in Scotland... ", (Assistant Lecturer, KUHeS BT)

'Mostly my knowledge on simulation-based education has been through literature review. I have since published two papers on simulation-based education; a joint publication; but I had also participated in a training on simulation organized by some Americans at Mzuzu Central Hospital ..., (Lecturer, MZUNI)

The findings above shows that significant knowledge and skills in simulation were obtained through trainings abroad or by visiting partners and least mentioned sources of knowledge and

skills are internet, college training particularly at Masters levels for educators and clinical settings. The responses also show that simulations give more of a practical perspective to the learning process as the instructor imparts both knowledge and skills to the students; at the same time the instructor can ably assess student's competency as well as pick and refine attitude issues in students. Further to that using simulation as a teaching method avails many benefits to students, patients and quality of care provided with improved skills.

Review of nursing and midwifery syllabi from NMCM and nursing and midwifery curricula documents in training institutions revealed two factors influencing implementation of simulation hereto discussed.

Dearth of simulation as a teaching method in Nurses and Midwives Council of Malawi (NMCM) Syllabi

Desk review conducted at NMCM Secretariat and in nursing and midwifery training institutions revealed significant gaps on the use of simulation in nursing and midwifery education despite NMCM as the regulatory body of nursing and midwifery education in Malawi having simulation guidelines. Eight NMCM nursing and midwifery syllabi (as shown in Table 2) were reviewed, but none of the syllabi stipulated simulation as the teaching method apart from just stipulating transformative, innovative and discovery teaching methods. NMCM has simulation laboratory guidelines developed in 2016 with funding from ICAP under Nursing Education Partnership Initiative Project; but the guidelines have never been implemented in the training institutions and were not accessed in all training institutions and health facilities under study. Both the registrar and training specialist at the council concurred with these findings:

“.....I don't think you will find simulation as a teaching method in the syllabi being reviewed.....developers of syllabi from various training institutions preferred to stipulate their own transformative, innovative and discovery teaching methods in the curricula documents. But in 2016 the council got funding to develop guidelines on simulation, which we have failed to implement in the training institutions to date due to financial constraints.....I hope this SBE (Simulation Based Education) project will help us implement the guidelines in the training institutions.”(KII, The Registrar, NMCM).

“If you don't find simulation in the syllabi, it is because the reviewers of the documents replaced all teaching methods including simulation with transformative, innovative and discovery methods but I have remembered that we have simulation guidelines being sold here so that you can see it” (KII, Nursing and Midwifery Training Specialis, NMCM).

Conundrum of Knowledge of Simulation versus Objectives, Content and Teaching Methods in Nursing and Midwifery Curricula in Malawi

The participants demonstrated knowledge of simulation and mentioned of gaining knowledge and skills on the use of simulation from training colleges, nursing and midwifery educators. However, review of curricula documents in all training institutions revealed conundrum of trying to implement simulation in nursing and midwifery education without being explicitly reflected in module objectives and contents except mentioning it as a teaching method.

"People have knowledge but have minimal skills because the environment in which they are operating does not allow transfer of the knowledge into skills; right from preparation as educators they did not have enough time and exposure to use simulation themselves. It starts from the point where one is being developed, if the preparation lacked knowledge and skills in simulation. Even in our syllabi documents, simulation is not explicitly mentioned, we assume educators stipulate it un innovative teaching methods in their curricula documents. Unless it is clearly stipulated, the use of simulation remains a challenge in their teaching.... N&M Education and Training Specialist, NMCM

While some of the participants demonstrated minimal understanding of simulation as a pedagogic teaching method, majority of participants in all categories of research subjects including educators, students and practicing nurses and midwives had explicit knowledge of simulation as exemplified below:

"Simulation is where you create a scenario out of what you are teaching; similar to the actual case, using human simulators or high fidelity models; which you can set to respond in a specific way so the student will learn in the artificially created environment (which is closer to the real environment they will find in the clinical area); the aim is to ensure safety and that the student has achieved competency before facing the actual patient..." (Lecturer, St. John of God Nursing College)

"This is learning where a scenario is created, a skilled person provides instructions relating to the real-world conditions; students or whosoever undergoes the simulation is supposed to understand and act/respond in accordance with the given instruction. It is very effective in assessing and evaluating if participants have grasped the desired outcome of a particular topic or procedure." (Chief Nursing Officer, Kamuzu Central Hospital).

Participants precisely indicated that only if educators' knowledge of simulation was explicitly transferred to curricula documents and reinforced in clinical teaching, acquisition of nursing and midwifery skills by students and graduates would bring tremendous improvement in quality of patient care.

"I don't think during my training I covered anything on simulation apart from objective structured clinical examinations during which we were given scenarios, I wonder if we could not have benefited more if it was included in our curriculum." Chief Nursing Officer, ZCH

The results further identified challenges associated with use of simulation-based education in nursing and midwifery training institutions in Malawi. The study results showed that 245 (83.6%) of the participants had never used simulation and 225 (91.1%) of those that had used simulation reported to have had challenges with use of simulation. 217 (74.1%) participants mentioned inadequate/lack of resources as a major challenge. Among other challenges raised included lack of experts/expertise, appropriate simulation infrastructure, skills laboratories, teaching hospitals and equipment which seemed to significantly influence implementation of SBE in Malawi.

Higher recognition of lecturers as a resource for simulation by both students and bedside nurses and midwives signifies that if lecturers are empowered with knowledge and skills in simulation, they can significantly impact on acquisition of skills both in training institutions and clinical settings

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